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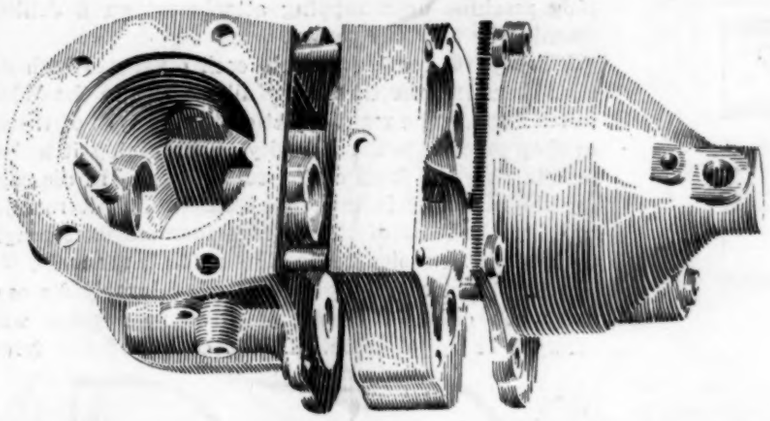


The Design of Die Castings

By
M. Stern
CHIEF ENGINEER TOLEDO PLANT
DOEHLER DIE CASTING CO.

Die casting is an easy and satisfactory method of producing small parts the nature and use of which do not demand a more resistant material. Since it is now possible to run aluminum and even brass in the casting machine the field for die-cast parts is greatly extended.

THE die-casting industry started with alloys of zinc, tin and lead mixed with no small amount of ignorance as to their properties, and the purchaser got little warning of the limiting conditions under which the castings could be used so far as thermal, chemical or mechanical conditions were concerned. Zinc die castings, for example, were used in contact with mineral acids and alkalis in which they were soluble, in water which corroded them, or under high temperature conditions which caused them to deteriorate. Die castings were also used for strains that would tax even steel, and the inevitable result was failure.

All these difficulties have been eliminated with the growing knowledge of the art and the discovery of new alloys. With the development of aluminum die castings a new field was opened, which has now assumed immense proportions. The latest achievement is the die casting of finished parts of brass, which opens an entirely new field for parts not sufficiently strong in the white metals. It is evident, therefore, that the die-casting industry has become a very important branch of the nonferrous trade, and it is very probable that the uses to which die castings are put will increase rather than decrease in the future.

In order to obtain the most efficient results, both in economy of first cost and in durability, die castings, like anything else, must be designed with certain preferences in mind. In going through a die-casting plant, while one will see castings in endless variety they can nevertheless be grouped into certain general classes. One class, for example, may consist of threaded pieces; another may have engraving, such as numbering wheels and dials, and still another may be grouped into gears, bushings and elbows. While each of these will be treated separately there are certain general principles that would apply to all.

In die castings, the elimination of sharp corners is very important because of the rapid chilling to which they are subjected. A strained section is set up at a sharp corner and a crack will develop either while in the die, due to the natural shrinkage caused by solidifying, or while in use if the casting is placed under the least excess strain. Fillets should therefore be freely used.

Thin, flat surfaces should always be ribbed, especially if the casting is large. Ribs serve a double purpose because they act as feeders for filling the mold and also prevent the casting from being distorted and warped out of shape in handling while still hot. To insure the best results in small die castings the minimum wall stock that can be cast in tin and lead alloys is $\frac{1}{32}$ in., in zinc alloys $\frac{5}{64}$ to $\frac{1}{16}$ in., in aluminum $\frac{5}{64}$ to $\frac{3}{32}$ in., and for larger die castings the wall stock should be at least $\frac{1}{32}$ in. thicker than these figures.

With tin and lead alloys holes as small as $\frac{1}{64}$ in. in diameter can be cast; in zinc alloys the minimum would $\frac{1}{32}$ to $\frac{5}{64}$ in., while in aluminum it would be $\frac{3}{32}$ in. This diversity is accounted for by the difference in shrinkage of these alloys. Holes of small diameters should be as short as possible because of the tendency of the fast-flowing metals to bend the cores. All holes should be provided with some draft to minimize the strain upon the castings in withdrawing the cores. The amount of draft needed depends upon the depth and diameter of the holes. As a general rule it varies from 0.001 to

0.010 in. for the low-melting-point alloys and 0.005 to 0.020 for aluminum alloys. Approximately the same rule applies for the sides of die castings which have a fairly deep draw.

Parts such as covers, knobs, soundboxes, etc., can be

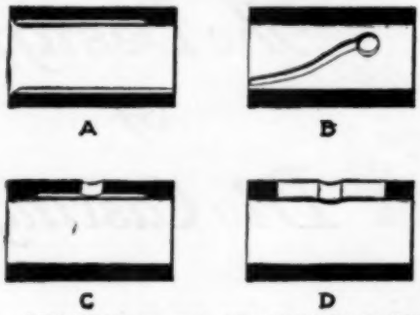


FIG. 1. EXAMPLE OF OIL GROOVES IN BUSHINGS

cast with a knurled edge if so desired, but the knurl must always run straight. Matting of any desired design can be furnished, and it greatly improves the appearance of a casting, particularly when used as a background for engraved characters.

Whenever possible engraving should be specified as "raised," as it is the simplest to produce and can often be punched or hobbed into the mold. On the other hand engraving which is "depressed" on the finished casting must be raised in the mold and for that reason is much more expensive. It also requires the milling away of a considerable amount of stock, leaving only the numbers or letters to stand up in the mold.

If the engraving must not project above the surface of the casting one can use "raised" engraving on a panel depressed into the casting the height of the characters instead of "depressed" engraving, and though this method might not be as neat in appearance as depressed engraving it is much cheaper and often answers the purpose just as well.

Another point to consider is the casting of threads

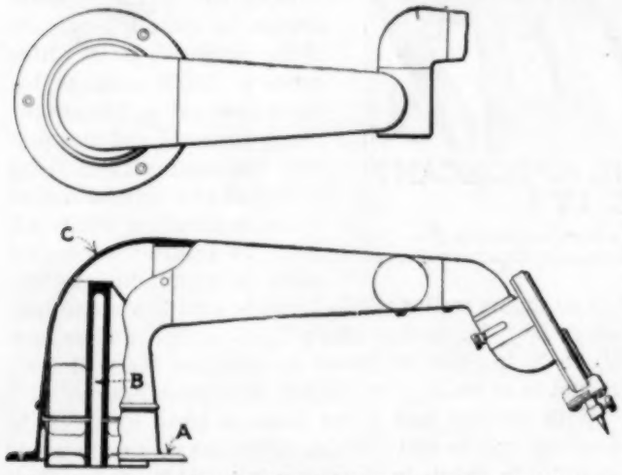


FIG. 2. DIE-CAST TONE ARM FOR PHONOGRAPH

and the extent to which it can be done. As a rule all external threads can be die cast and they usually show two fine seams where the mold parts. In special cases where greater accuracy is required an external thread can be cast without any seam at all. It is not practical, however, to cast internal threads below approximately ⅜ in. in diameter. The reason becomes apparent when it is considered that the threaded core must be turned out of the casting by hand under unfavorable heat conditions and the two or three men operating the machine are delayed by just that much. On the other hand holes of that size can be more economically tapped with a tapping machine or a tapping attachment on a drilling machine by only one person.

When parts that screw into each other are both die cast, including the thread, by all means use the Whitworth form. The main objection to this type of thread in shop practice is the difficulty of machining it and of maintaining the form of the cutting tool. In die casting this difficulty is entirely absent, while the rounded tops and bottoms of the threads increase its strength and permit an easier flow of the metal in the mold.

Gears intended for light service are largely die cast. They can either be bevel gears or spur gears with straight or spiral teeth. In the center of the driver

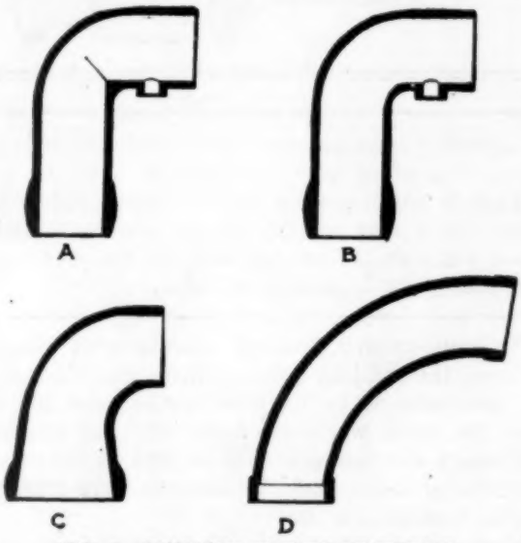


FIG. 3. VARIOUS STYLES OF ELBOW

gear a square or oblong hole can be cast just as easily as a keyway, and this is a favored design for oil-pump gears. As is well known shrouded teeth are considerably stronger than the teeth of an ordinary gear, and for that reason shrouding on one side should be specified whenever possible. This construction can easily be die cast and has the additional advantage of serving as a good surface for gating.

Babbitt bushings are used in large numbers for automobiles, and Fig. 1 gives the various styles of oil grooving which can be die cast. The simplest construction is that of letting the grooves *A* run either the full length of the bushing or running out at one end only. A more difficult construction is shown at *B*, where the groove follows a steep spiral. When, however, both ends of the groove must be closed, as at *C*, it is known as an undercut oil groove and is the most expensive to produce. A simpler substitute which has been used in actual practice is shown at *D*, where the groove is cast clear through the wall stock.

During the past 10 years the die-casting industry has been turning out increasingly large quantities of parts for phonograph tone arms, which convey the music from the disk record to the tone chamber. Fig. 2 shows a tone arm, the design of which is extensively used, and illustrates the possibility of die castings in making a

cheap assembly. The base *A*, which is fastened to the cabinet, is cast with a steel pin insert *B*. The insert fits freely into a long boss supported by two thin webs from the sides of the elbow *C*. The weight of the arm comes on the top of the steel pin, and on account of the point support there is very little friction.

The only necessary machine work on the entire tone arm is the tapping of the small holes; the castings are then ready for polishing, plating and assembling.

Fig. 3 gives a sectional view of various types of elbows. The most common type has the inside corner sharp, as shown at *A*, and is the simplest to produce. At *B* and *C* are shown elbows with different degrees of rounding on the inside corners. At *D* is shown an elbow the inside of which is on the arc of a circle. In special cases elbows with even more complicated turns and bends can be produced. Die-casting methods are essentially efficiency methods because an accurately finished product is obtained directly from the ingot without the intermediate steps of machining operations and all the handling attendant upon it, and this becomes more appreciable when large quantities of parts are needed. The latest die-casting machine is capable of pumping about one ton of lead alloy an hour into the molds and produces very satisfactory castings. It is therefore not surprising to find the die-casting industry with orders for war material that run into millions of parts and yet perfectly able to cope with the production demands. Among the pieces made by this process may be mentioned bouchons for hand grenades, plugs for trench mortars, cams for machine guns, and also parts for depth bombs, floating mines, naval torpedoes, range-finding instruments, gas masks, aerial bombs, airplanes and many other contrivances for suppressing *kultur*.

Die castings are also made in large quantities for devices that are useful in peaceful pursuits, among which may be mentioned cream separators, moving-picture machines, typewriters, vacuum sweepers, automobiles, and parts for an endless variety of vending machines.

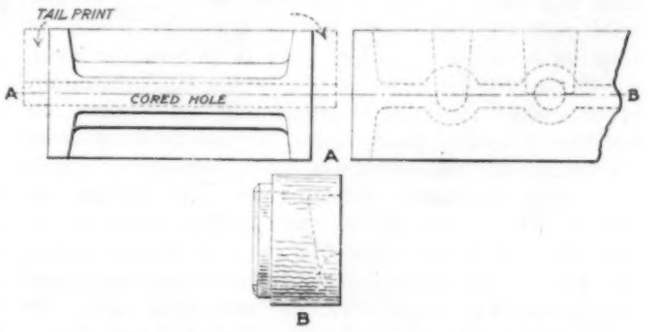
Two Ways of Molding a Casting

BY M. E. DUGGAN

It has been frequently remarked that the operations of the molder are to a large extent predetermined by the patternmaker. The pattern shown in the sketch is of a class of work that is being made in the pattern shop every day. It is a simple piece to make and mold, and I made it in a way that nine out of ten patternmakers would make it, yet when it reached the foundry the molder changed the whole molding operation, using slab cores in the coring of the holes.

The over-all dimensions are: Depth, 7 in.; width, 12 in., and length, 42 in. There are eight 1¼-in. cored holes. I made the pattern split through the middle to be molded one-half in the drag and one-half in the cope. For the cored holes I used round prints. I considered this to be good and practical patternmaking and molding. I had seen other patternmakers make similar patterns in this way, and the method is described in books on foundry practice, but this particular foundryman had another method which from the patternmaker's viewpoint might be considered bad practice. However, I have found it to be a very good one, and now whenever possible I make my patterns in the same way.

The pattern was altered by the molder who fastened the two halves of the pattern together. This changed the parting from the center to the top of the pattern, thus making it necessary to mold the whole of it in the drag. The body of hanging sand forming the mold for the center of the pattern was supported by means of gaggers placed in the cope flask. With this method no special rigging up of the cope flask was necessary. For a split pattern a special-rigged cope flask would have been required and the making of this flask would involve material, time and labor in its construction. It is for this reason that the molder changed my method and molded the pattern in the drag. In order to make the parting at the top I would have the pattern returned to the pattern shop, make and fasten dovetail core prints to the sides of the pattern as shown in dotted outline, and make a half core box as at *B*. This is how the molder did the job and in less time than would be required to take the pattern to the pattern shop. From a stock slab core (every foundry keeps on hand cores of various shapes) the core maker cut cores with a hacksaw blade, rounding them at the bottom with a file to fit over the print, tapering at the sides, and flush with the top, or parting, edge of the pattern. These he placed in position and rammed with the pattern, and when the ramming was completed these 16 cores were extracted from the mold, the pattern withdrawn and eight 1¼-in. round stick cores were set in the mold. The slab cores were then put back in place and the mold



THE PATTERN AND PROPOSED CORE BOX

closed. This is one of the practical details in connection with molding work that is worth knowing.

Some time ago I read a very interesting article in one of the technical journals illustrating and describing the purpose of the dovetail core print and how it is made; also the core box. The method is the long way and one that requires plenty of time, but it is well to know it; yet it is the short method that counts when a fellow is in a pinch on a rush job.

The Motion Picture and Its Relation to Industrial Problems

By ERNEST A. DENCH
Author of "Motion Picture Education"

The use of motion pictures for various industrial purposes is here outlined. Suggestions are given regarding the instruction of salesmen; the solving of efficiency problems; the obtaining of help, and other puzzling propositions.

MANY times a manufacturer has had to choose between paying $100 a week to an efficiency engineer or $600 in a lump sum for an industrial motion picture. And when his appropriation has been limited, as has proved the case in many instances, it is little wonder that the motion-picture idea has been discarded. I frankly admit that industrial motion-picture work is expensive if judged by other efficiency mediums, and it has become more so since the war-tax bill went into effect last November when a tax of about five dollars a reel was imposed. Yet a lot depends on what one considers an exorbitant amount. It is only fair to point out that industrial motion-picture work has not yet reached the stage where the small manufacturer can indulge in it on an elaborate scale. It seems that the larger the manufacturer the more he can profitably spend on industrial motion-picture work, and as the money used in this way does not go as far as it does in some other things it explains why the small manufacturer has his hands tied to a certain extent. The time will come, no doubt, when industrial motion-picture work will be possible on a moderate outlay. As it is now, however, the large manufacturer not only has the advantage of a greater available appropriation but because he operates a larger plant employing hundreds of men, his industrial motion-picture work returns a bigger investment for every dollar spent, and because the motion picture is at its best when employed in connection with big undertakings. It is not always the case that the larger plant must have a motion picture correspondingly longer. In the large plant often the chief difference is that a larger force of men is engaged on each process. It is a simple matter to film just one man or a group of men engaged in the same operation, consuming no more footage than is necessary in photographing similar work in the small plant.

However, we are at war, and in these strenuous times it is not so much the expense to be considered as it is results. Despite its disadvantages for the small manufacturer, industrial motion-picture work has advantages which, if rightly employed, will help win the war. And the manufacturer's greatest object today, whether he be engaged in the making of war products or not, is to win the war.

It is no discredit to the manufacturer if he cannot keep his sales force intact. The war, with its continuous combing of men, is something that he cannot control, and he must have another man ready to step into the shoes of the one who has left overnight. But his organization is going to fall down like a pack of cards if the new salesman does not know the product from A to Z. Training takes time, and as time is precious the most speedy and efficient method must be found. Machinery is not easy to demonstrate before a man who knows little or nothing of it. No doubt the reader has been to a photoplay theater when an industrial film has occupied the screen, and if so he could not have failed to observe how the small yet important details were lucidly explained, and how the close-ups emphasized every little point. What the industrial motion picture has done for one manufacturer it can do for another. A proposition can be put before the salesman in half an hour or less. The eye appeal is the leveler of intelligence, so after the film has been screened the newest salesman in an organization can quickly acquire a knowledge of the output that will compare with that of the man who has been on the road for years. The former salesman will, of course, lack other salesmanship qualities that have been gained only by actual contact with purchasing agents and other executives, but the motion picture will supply the necessary groundwork. The same film revised can be shown to prospects. Every business man is now so busy helping to win the war that machinery must be taken to him—not him to the machinery. The motion picture allows a salesman to carry a tractor in a suitcase to the prospect. The salesman improvises a screen with a white sheet or window shade, connects his portable projector to the electric-light socket and screens the film, at the same time bringing out the points he wishes to emphasize.

Not only is the prospect convinced of the worth of the machinery, but the oftener the film is screened the more the salesman knows about it. There is no chance for him to make a misstatement and thereby kill the sale, because the motion picture is always on hand to tell the truth.

The motion picture, not the salesman, sells the machinery. All the salesman has to do is to clinch the deal after the motion picture has convinced the prospect. This is an important point to consider with the present scarcity of capable salesman.

We hear of so many things to win the war that we take some of them with the proverbial grain of salt,

but no manufacturer will dispute that efficiency is a far more effective weapon than overtime.

The policy of any plant calls for the largest output in the quickest time. An efficiency engineer may use his brain; nevertheless we know there are limitations to what he can accomplish. The efficiency engineer is cold and calculating; he has to be. His methods are so obvious that when they change the plant routine everybody from the superintendent down to the boy beginner notices the difference. Too often his forceful methods give the employees the impression that they are machines. And workingmen resent this. They may not always show their disapproval outwardly, but they fail to put the pep into their work that they should.

The perfect efficiency engineer is suave, diplomatic, tactful and subtle. As such an individual does not exist in the wide, wide world, we must search elsewhere. Enter the motion picture. A film is taken, showing in detail every process of manufacture. It is screened before the employees. Each man sees his work on the screen. There is nothing deceptive about it. The man sees himself as he really is. In a perfectly natural way he ascertains whether his work tallies with the screened explanation of each process. This is one of the subtle results the film produces.

Then the man is shown just what his piece of work means "over there." The scene shown is one that has been taken at the firing line or on shipboard. The workman is flattered at seeing how he is helping to win the war. It makes him determined to do his bit every day. The climax follows. The employee is shown how other departments are forced to slow up when his department falls below the average. If he had any doubts before of what he as an individual means to the smooth running of the plant he is now convinced.

A Free Industrial-Film Service

The free-film library established by the Bureau of Commercial Economics, Washington, D. C., helps to solve the unskilled labor problem with the minimum of expense. Lectures and textbooks are excellent in their way, but they can be made doubly effective as well as attractive by the coöperation of the motion picture. The motion picture begins where the lecturer and textbook leave off. The motion picture, instead of trying to explain technicalties, shows them without the need of wading through explanations in order to get at the gist. The appeal of the motion picture is universal because the motion picture knows all languages.

The Bureau of Commercial Economics has reels available dealing with practically every industry. Take, for instance, the textile industry. The list of textile subjects includes wool growing, carpet weaving, the glove industry, lace making, the hat industry, cloth manufacture, the silk industry, making plush seating, cotton growing, making Scotch tweed, sheep shearing in Australia, and so on.

Each Subject Is Treated with Great Thoroughness

The bureau is prepared to lend its reels through the various coöperating universities, which act as service stations, to any manufacturer requiring the use of them. The stipulations for service are as follows:

1. Payment of transportation charges from and to the distribution center.
2. The films shall be used in standard motion-picture projectors handled by competent operators.
3. A report of films used and attendance shall be mailed after each performance to the distributing center.
4. Films shall be returned immediately after use.
5. No fee whatever is charged or accepted for the use of the films of the bureau.
6. No admission fees to the public are permitted to be charged, nor are collections during or after the exhibition permissible.
7. Applications for the service must be made on a standard application blank.

The Application Blank

In filling out the application blank, which may be obtained from Washington, the user must promise to show the reels under the rules and regulations given above. Next he must give the size of auditorium, type of projector-focal throw, how often films are required and the type of audience.

The booklet got out by the bureau, besides giving a partial list of available subjects, tells how the bureau is maintained:

"The bureau is maintained through contributions and annuities.

"Contributions are invariably voluntary, and no one is authorized to solicit the same.

"No film is shown for a money consideration under any circumstances, nor is preference given to a film or a subject on account of a contribution.

"Contributions are received and acceptable only to an amount sufficient to cover transportation charges, insurance and upkeep of the films and the expenses of administration, as the bureau is not operated for profit and has no capital stock.

"The surplus funds of the bureau will be used in the production of welfare films, first aid to the injured, including the resuscitation of the drowning, the emergency methods of rescuing imprisoned miners, and the awakening and development of civic pride and patriotic citizenship."

In describing the methods by which the bureau operates, the booklet says:

Coöperation of Universities

"Coöperation of the universities consists in displaying the pictures, thus affixing their seal of approval as to their character and quality, and then circulating them in their community centers to adult audiences who are in sympathy, as their own university stands sponsor, for which extension work many states make appropriations.

"The bureau does not wish to encourage any institution to engage in visual instruction or to incur any expense whatever in connection therewith unless it feels it is a privilege and that substantial benefits may accrue therefrom, in which event the bureau will be glad to contribute films if the institution install a standard motion-picture machine of any well-known make and the same be operated by a capable and competent operator.

"The bureau wishes to caution any institutions using films to strictly comply with the fire regulations, obtaining in local communities and observe the laws relative to censorship, in the belief that better results

accrue if collision with local authorities is avoided. Experience has shown that substantial support is given by local peace officers to this philanthropic work wherever effort is made to protect and save harmless those who seek information and enlightenment.

"The bureau requests that all communications from manufacturers and others furnishing films, relative to the display of films or attendance, be forwarded to its office in Washington for attention, as the bureau does not wish to have any hardship imposed upon the institutions in connection with its work which the bureau can relieve.

"All applications to the bureau for its films are forwarded to the coöperating universities from whose jurisdiction the request has come, as the bureau does not seek any publicity for what it is doing, but prefers that such credit be given to the local institutions in the belief that this will develop civic pride and effort on the part of the public to support and encourage the movement. The bureau is quite willing to make its contribution in this behalf as an anonymous giver.

"The service of the bureau is also available at the present time in Canada, Latin-American republics, India, China, Japan, Australia, New Zealand and South Africa, with titles and subtitles of all films in the language of the countries addressed."

Probably the best place in which to give lectures is a local motion-picture house. Aside from the lack of the necessary facilities in many industrial plants there is the expense to be considered. With a projection machine at $250, a fireproof operating booth at $65, a screen at $29, a case of carbons at $22, and various other small accessories totaling $23, nearly $400 is invested in the initial installation alone. In hiring the local motion-picture theater for the purpose some morning or afternoon when the theater is not in use the only expenses, aside from the rent, will be the operator's time and the "juice"—probably not more than 75c. an hour for both. Since four reels can be shown in that time a weekly lecture should cost only a few dollars, including the expressage on the reels.

The manufacturer must take into consideration the fact that the labor problem will become worse instead of better as the war continues. He has already felt it, more or less, by loss from voluntary enlistments and draft calls, and he will, no doubt, be forced to hire any sort of labor he can get. For training these employees the most direct route is the motion picture.

Securing Labor by "Movie"-Slide Advertisement

The manufacturer can take a leaf out of the Government's book. In its urgent need of stenographers and shipyard workers the Government has advertised for them by slides at the motion-picture theaters. The Government's problem is national; the manufacturer's problem is local. So it is essentially a matter of circulation rather than methods. While the Government shows its slides in several thousand theaters extending across the continent, all the average manufacturer needs for his purpose are the motion-picture theaters of his own or near-by towns. The right medium is there, but the slides must be made in an attractive, brainy way.

The number of slides used, how elaborate they are and the local theaters in which they are shown, depend entirely upon the number of employees needed. If the shop is small and needs only a few hands a slide like the following should suit the purpose:

"Several of our workers have left to join the army.

"What young women will fill their places at the same salaries?

"The work is light and the hours are easy."

Have this announcement placed on a typewritten slide. If the operator employs the stencil process this will do. If neither of these two methods are at his disposal, the neat, hand-written slide will serve the same purpose. However, for an outlay of a dollar or two a local photographer may be able to prepare a slide in colors, with a soldier in the top left-hand corner beckoning to a young woman in the top right-hand corner.

The larger manufacturer may have to put out a series of slides and screen them in the most desirable local theaters before he obtains his full quota of the right kind of help. However, the same slides can be used from time to time when men and women are needed to replace those who have been drafted, so the expense it not much. Here is one such slide to show during a labor drive:

"Young women! Serve your country and help build airplanes.

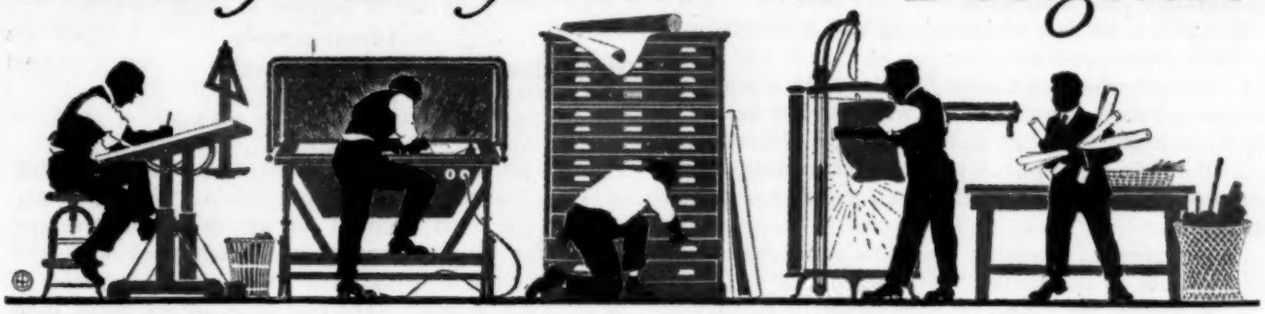
"Good wages, easy hours and pleasant, light work."

This slide may prove perfectly satisfactory so far as applicants are concerned except that there are not enough of them. Assuming that the manufacturer has tried the slide out in the theater nearest to his plant I would suggest that he make arrangements with another show in the same section to screen the slide. He can repeat the same process with the local theaters until he is fully supplied with competent help. This plan will save the manufacturer the expense and trouble of having a number of slides circulating in the local theaters. It will be a simple matter for him to withdraw the slide at a moment's notice with the least friction and expense.

If it is found that a single copy of a slide will suit the purpose any local photographer or slide manufacturer will make an artistic announcement for $1 and up. If several copies are wanted of the same slides they will cost from 25c. to 75c. apiece. To this must be added the cost of screening the slide, which will vary according to the seating capacity and location of the theater. The average cost of showing labor slides for a single week will be in the neighborhod of a dollar.

The newspapers are full of want advertisements, but slide want advertisements are the exception. If an advertisement is wanted to appear without being sandwiched between other want advertisements use the "movies." Even though want-advertisement slides may become as popular as those of the newspaper the former will continue to be shown separately.

Series for Draftsmen and Designers



Organization and Wage Payment for the Drafting Department

BY J. B. CONWAY

This article pertains to the organization of the drawing office and to a wage-payment system designed to effect maximum results if properly applied. The points brought out are based upon practical experience in the application of this system to shop routine under conditions similar to those set forth.

DRAFTSMEN, collectively, represent a high order of intelligence and skill. It is a prerequisite to their vocation. On account of this it is essential that some method of systematizing the work in the drafting room be perfected and the men trained in order that maximum results may be obtained.

The owner of a thoroughbred horse does not put him in harness and turn him loose on a track, expecting him to do a mile in record time because his ancestors were famous for speed. Nor does he hope to attain results until the horse has been put through an extensive course of training.

Training, encouragement and persuasion are necessary features for obtaining the best results from workmen, though these features are conspicuously lacking in the drawing room. The draftsman has laid a foundation for success in his work by previous education, but on entering the designing room he must be specially trained for the particular work he is to engage in.

Among the several types of men to be found in the drawing room, the most conspicuous are the originator and the detailer. The first reaches his maximum efficiency when on development work, but after originating an idea he is satisfied to let another develop it in detail. The latter is peculiarly adapted to detail work. He delights in perfecting another's ideas and he will be found unusually careful and painstaking, even to the extent of being fussy.

Any man is capable of being developed into an expert in the work for which he is best fitted. Each possesses the power to do something worth while, but sometimes it requires opportunity (which is only in the power of those in authority to grant) to obtain the best endeavors of a workman. Without a chief who is broad-minded, a student of human nature and capable of selecting men for the work for which they are best qualified, the problem of procuring maximum efficiency is not easy of solution.

Labor conditions which have prevailed since 1914 make it necessary to give this matter serious thought. The influx of men to the industrial centers, coming from all branches of mechanical work in the drawing room and accepting responsibility for the successful termination of a task with which they are entirely unfamiliar, only complicates the situation.

Aside from the patriotic desire to aid in the present exigency many men have been attracted to new fields by the unprecedented wages being paid for all kinds of work.

FIG. 1. ORGANIZATION OF DRAFTING ROOM

There is no evading the fact that draftsmen, as a class, have in the past been underpaid, and they have not received due recognition for their efforts. Until recently the drafting department was looked upon and treated as a necessary evil. But the sudden change to one of recognition and demand has made it necessary

that methods be employed to select and train men according to their qualifications and to reward them commensurately with their skill.

The first essentials of organizing and maintaining a drafting department are:

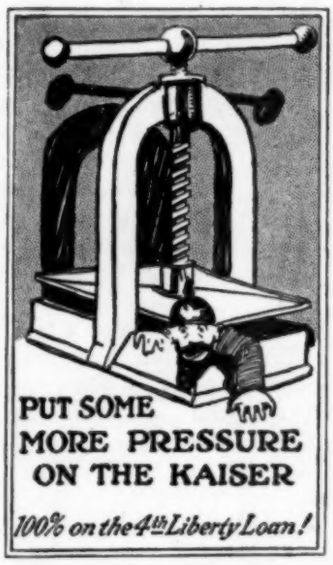
1. A chief who is not only familiar with mechanical design and shop operations, but who also has executive ability, initiative and tact and a knowledge of developing individual effectiveness. A genius lacking in diplomacy will not accomplish as much as an average man possessing tact.

2. A system of planning the work and properly assigning jobs to the various workmen.

3. A means for collecting and properly classifying data, drawings, etc., for immediate reference.

4. A sufficiently comprehensive system of time keeping for all classes of work.

5. Provision for adequate compensation for services which will act as an incentive. Rapid progress can be expected only after the work has been standardized, and this can be accomplished as easily as can shop operations. For instance, various small tools, such as bars, cutters, special drills, gages, etc., may be drawn up in skeleton form, leaving space for various dimensions to be filled in as required. This practice is followed to a great extent in most large drawing rooms at present. Titles, lettering, size of drawings, etc., readily lend themselves to standardization. Larger or smaller units required for manufacture should follow the general design previously adopted, and parts that can be used advantageously on other sizes should be employed. Chart 1 will convey an idea of the functional organization of the drafting department and may be elaborated or modified to suit the local conditions.



To obtain maximum results the work must be properly planned, preferably by at least two men, and when this is done the design is worked up from sketches by the draftsmen and detailers, each being assigned to the work for which he is best qualified.

Checking should be performed by one familiar with the requirements of the work and who has a sense of honor and possesses tact so that friction and discontent may be lessened. Tracing and minor jobs should be executed by beginners.

The handling of the records and the time-keeping system should be assigned to one who is familiar with clerical work or shows an aptitude for it. He should be trained for the detail duties of the office.

In the absence of more exact data the following method is suggested as a basis for establishing the length of time required for a drawing or tracing.

Assume that the total number of tracings made during a given period is 90. These are classified according to their size, ranging from a D sheet, the smallest, to an A sheet, the largest. Of the total number made 10 are A sheets, 20 are B sheets, 35 C sheets and 25 D sheets. They represent respectively 11, 22, 39 and 28 per cent. of the whole. The total amount of money paid for wages is found to be $2000.

For obtaining the average cost per tracing according to size we have the formula,

$$\frac{\text{Total cost} \times \text{per cent. of total}}{\text{No. Drawings made}}.$$

The A sheets are then found to cost

$$\frac{\$2000 \times 11 \text{ per cent.}}{10} = \$22 \text{ each.}$$

This of course includes the drawing when estimated in this manner. After ascertaining the cost per tracing the next step is to arrive at an average rating for all workmen directly concerned with the making of the drawing. Say this average is found to be 40 cents an hour. The cost of A sheets would then represent a time consumption of 55 hours. The average cost and time consumed can readily be determined for the other sizes in the same manner. The average time obtained can be established as a standard provided existing conditions obtain in the future. Otherwise allowance should be made for contemplated changes liable to affect the time. When time studies are necessary they should be conducted by those familiar with the work and capable of analyzing the various operations involved in making a drawing, including the mental work that is entailed. This man should have had experience on the board before attempting time studies. The work having been planned and standard times established the draftsman is ready to proceed with his work upon a premium basis. On being assigned a job he registers the time started on his job ticket, Fig. 2. He knows at once that he will be required to perform his task within the standard time given on his job ticket; he also knows that for expediting the job with accuracy he will be rewarded above his hourly rating. The rewarding is accomplished in the following manner: Adopting the standard time as a basis equaling 100 per cent., we have 50 hours equals 100 per cent., which is the efficiency the draftsman should attain. In the event he is able to better this time he receives a premium or increased compensation. Suppose he completes the job in 40 hours. He has reduced the time 20 per cent. and on a premium basis would receive his hourly rate + 20 per cent., or in other words 120 per cent. × hourly rate × hours worked. In this case, with a rating of 40 cents an hour he would receive 48 cents an hour for 40 hours, or $19.20 as against $20 he would have received for 50 hours work on a day-work basis. He has saved 10 hours for himself and employer and increased his hourly rate 8 cents, or 20 per cent.

To counteract the tendency to undue haste by the sacrifice of accuracy and to aid the draftsman by showing him his weakness in certain matters a record should be made by the checker as to the nature of the errors found. The time required to correct them may be obtained from the job ticket of the employee doing the correcting.

If much time is lost correcting tracings it is added to the actual time taken to do the original work. For example, on a recent job of over 100 drawings a draftsman

made 33, taking 63 hours to do the work. The standard time was 3.33 hours per drawing. The average actual time was $\frac{63}{33}$, or 1.9 hours, representing a saving of 1.43 hours, or 43 per cent. But it was found necessary

ORDER NO. 18269 ACCOUNT NO. | DRAFTING DEPARTMENT JOB TICKET | REFERENCE SYMBOL 125-A

CLOCK NO. 718 WORKMAN'S NAME John Smith
PART NO. 125-A NAME Igniter Pawl
DESCRIPTION OF JOB Make drill jig to drill pin hole.

			DESIGNING
			DETAILING
			CHECKING
STANDARD TIME	HRS. 3⅓	HOURLY RATE .40 PREM. RATE .46	TRACING
ELAPSED TIME	17	AMOUNT EARNED D.W. $6.80	PRINTING
CORRECTING TIME	—	PREMIUM EARNED 1.02	MISC'LL
TOTAL TIME	17	TOTAL EARNED $7.82	PER CENT EFFICIENCY
HOURS GAINED	3	SIGNED Wm Smith CHIEF DRAFTSMAN	115
HOURS LOST	—		

	4–5:30 PM	4–8 AM	4–12 M.	4–8 AM	4–12 M.	4–5 P.M.	4 17									
OUT		4–8 AM		4–8 AM		4–5 P.M.	OUT	IN	OUT	IN	OUT	IN	OUT	IN	OUT	IN
IN	4–8 AM		4–12 M.		4–12 M.											

REMARKS: (HERE MAKE NOTE OF NATURE OF ERRORS ENCOUNTERED IN CHECKING)

Designing ability good.

Could improve in accuracy of calculations and lettering

INSPECTED BY E. A. M. (TITLE OF ONE RESPONSIBLE)

FIG. 2. JOB TICKET-FRONT AND BACK

to correct 26, or approximately 79 per cent., of the finished work at a loss of 10 hours in time, or 15.9 per cent. of the total drawing time. Instead of receiving an efficiency rating of 143 per cent. the draftsman lost 16 per cent. (anything over or under 0.5 per cent being added or dropped), thereby bringing his efficiency down to 127 per cent. Therefore, instead of receiving 143 per cent. × 40 cents he received 127 × 40 cents, netting him $32 instead of $36 for 63 hours' work. The correct-

ing was performed by a lower-rated man, so that the gain was not all lost to the company.

The draftsman and others working on a premium basis should at all times be guaranteed their hourly rating, and in failing to meet or reduce the standard time should still be compensated at their hourly rate.

The job ticket will cover the work in the average drawing room and will provide for the accumulation of data valuable for building up the organization. Although designed for use with the Stromberg electric time stamp, other forms may be used. It is preferable,

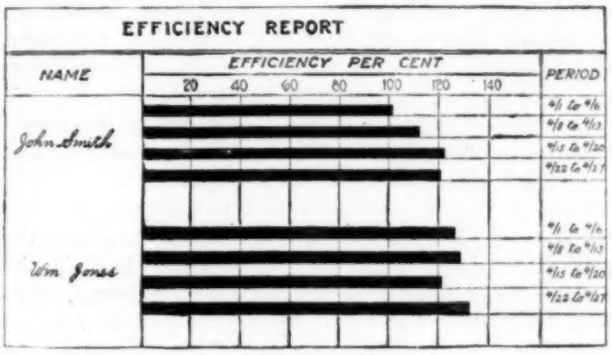


FIG. 3. EFFICIENCY REPORT

however, to have the time entries made mechanically rather than by hand.

An efficiency report issued weekly will be found to be a constant aid to the organization. Such a report is shown in Fig. 3.

Further assistance to the department may be had by maintaining a schedule sheet, or board, as shown in Fig. 4. After the work is planned and times established, entries of such are made on the schedule sheet. Notations regarding the progress of the work are made daily. Colored pins, tacks or crayon may be employed to designate the various conditions of the job. Red may be used for "jobs waiting" (and will be found very appropriate), green for "jobs working," blue for "jobs ready for checking," etc. The number of drawings finished daily may be entered under the date finished. The squares may be subdivided and the number of hours consumed also carried under the date if desired. Such a record is invaluable and almost indispensable, inasmuch as it shows at a glance the status of the job daily and dis-

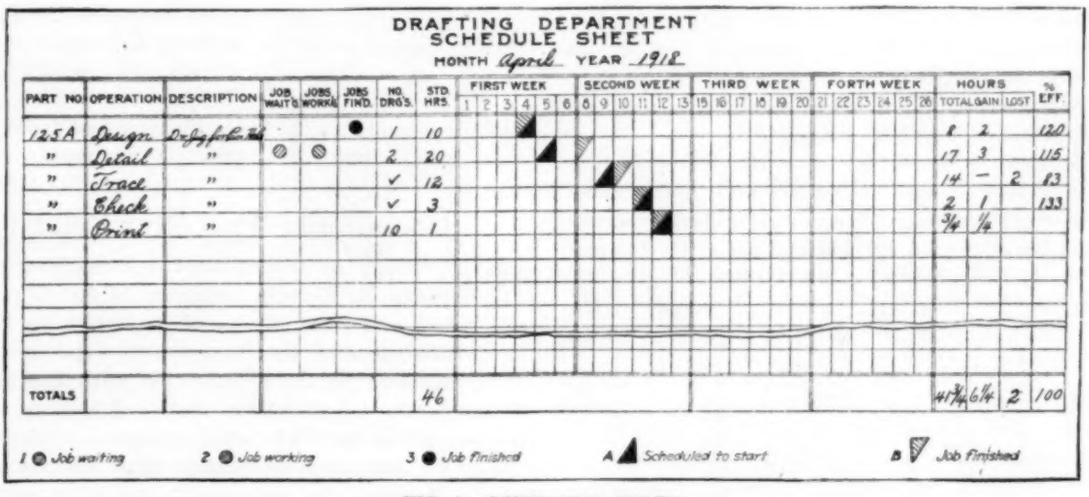


FIG. 4. SCHEDULE SHEET

closes possibilities for adding help when necessary or giving preference to other jobs.

The fact that the entire department, including planning men, designers and others, will improve in personal efficiency must not be lost sight of. As the system becomes firmly established it will be found that each man is putting forth greater efforts than formerly and he should be compensated accordingly.

Thus we find the premium system so flexible that it readily lends itself to being extended so that superiors, and in fact the entire department, may be compensated on this basis. Should the draftsmen, tracers and others collectively show an efficiency of 125 per cent., for example, those who were instrumental in planning and making conditions better would receive the same percentage of increase, or a fraction thereof, as may seem advisable. This practice would make for a spirit of coöperation and loyalty among all workmen in the department.

It is not within the scope of this article to go into details concerning the operation of the system and the obstacles to be encountered and overcome both in the routine and handling of the men. It is hoped, however, that this review will prove beneficial at least in some respects, to those employing draftsmen and especially to the draftsmen employed.

Simplified Stiffness Calculations for Shafts

By John S. Carpenter

It is not every day that one is called upon to figure the angle of twist in a shaft, and one is therefore inclined to get rusty with the necessary formulas. When the time does come, however, the background generally is composed of the general manager, who never used a slide rule in his life and usually refers to them as "guessing sticks"; the chief draftsman and a rattled draftsman, the last two working their slide rules at feverish speed. They start with the general formula and all goes well until they hit the torsional modulus of elasticity, and in the resulting answer neither can tell whether the angle of twist or deflection is 2 or 20 deg. The G. M. finally asks, "Well, what is it?" and getting some guesses for answers finally goes off and tells them to figure it out by longhand.

To avoid this uncomfortable situation I reduce the formula to a very simple expression and give a table showing how this awkward formula as generally given in the hand-books can be avoided and the shaft for any usual degree of twist figured in short order.

The torsion, or twisting, moment is equal to the twisting force multiplied by the lever arm about which it acts. Then let

T be the twisting force in pounds.

R be the radius or lever arm of force T in inches.

S be the stress in shear in pounds per square inch.

L be the length in inches between the twisting arms.

D be the deflection or twist in degrees.

G be the torsional modulus of elasticity.

d be the shaft diameter in inches.

From any mechanical-engineering hand-book we can get the formula

$$D = 585PRL\ Gd^4 \qquad (1)$$

as the angle of twist in degrees. The resultant stress created is

$$S = \frac{DGd}{2} \times 57.3\ L, \text{ which reduces to } \frac{104{,}700\ Dd}{L} \qquad (2)$$

The problem as it is usually stated is to find what size shaft will keep the twisting angle below a certain specified limit. We will proceed to find that. By transposing (1) and solving for d we get

$$d = \sqrt[4]{\frac{585PRL}{GD}} \qquad (3)$$

Now for steel the torsional modulus of elasticity is usually given as 12,000,000 lb. per sq. in. Inserting this value in (3) it reduces to

$$d = \sqrt[4]{\frac{PRL}{20{,}500\ D}} \qquad (4)$$

This can be further reduced to

$$d = \sqrt[4]{\frac{PRL}{D}} \times 0.0835 \qquad (5)$$

the intermediate step between (4) and (5) being shown to facilitate following the reduction.

If we specify that the angle of twist shall not exceed a certain value, equation (5) can be brought into the form

$$d = K\sqrt[4]{PRL} \qquad (6)$$

where K is evaluated as

$$K = \sqrt{\frac{1}{D}} \qquad (7)$$

For convenience a table is given below with values of K for corresponding values of D. All that is necessary is to select the proper value of K and then solve equation (6). Probably the easiest way to get the fourth root is to extract the square root twice.

TABLE OF VALUES OF K

D	K	D	K	D	K
.25	0.1180	2.50	0.0665	5.50	0.0545
.50	0.0991	3.00	0.0635	6.00	0.0534
.75	0.0896	3.50	0.0612	7.00	0.0514
.00	0.0835	4.00	0.0591	8.00	0.0497
.50	0.0755	4.50	0.0574	9.00	0.0482
.00	0.0703	5.00	0.0558	10.00	0.0470

Now then, should the problem be to find the twist for a given shaft we find the value of K from

$$K = \frac{d^4}{PRL} \qquad (8)$$

and by reference to the table the angle of twist can be found close enough for all practical purposes.

Locomotive Problems Solved

At a meeting of representative locomotive builders with Bernard M. Baruch, chairman of the War Industries Board, and other officials of the board, the Railroad Administration and the Government departments one of the heaviest problems connected with the direction of war work—an adequate supply of railroad locomotives—was solved. Plans were worked out whereby the output of American locomotive-manufacturing plants will be doubled, the increase being from more than 3000 on a prewar basis to more than 6000 completed machines. An equal distribution of the output to meet the military needs in France and the needs of the Railroad Administration for the steam roads of the United States has been provided by the chairman, which has met the approval of the interested Government officials.

Wigglers and Their Uses

BY HUGO F. PUSEP

A fairly liberal tolerance is allowed on a considerable portion of jig and fixture work going forward at the present time, and it seems an unnecessary waste of time to locate the various points on this kind of work by the unquestionably accurate but slow and tedious method of "buttoning up" when good enough results may be obtained by means of the common "wiggler."

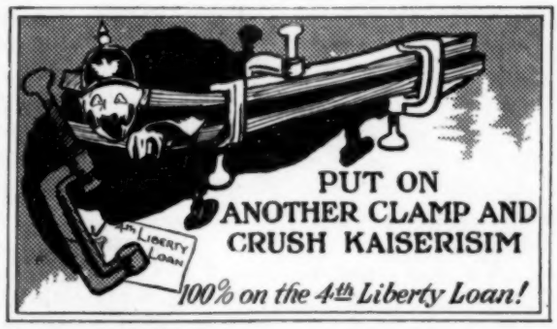
THE locating of holes for boring where the limits are fairly liberal can be speeded up by the wiggler method. While I have never seen a commercial wiggler that was satisfactory the home-made variety will accomplish the desired results if made right.

The essential features of a good wiggler are these: A holder with a taper shank to fit the machine spindle or with a straight shank to be held in a drill chuck, and a sharp point or scriber so mounted in the holder that it may be made to run perfectly true regardless of whether or not the holder is true.

Cross lines previously laid out on the work may then be brought into alignment with the point of the wiggler, the adjustment being observed with a magnifying glass if accuracy is desired.

A crude example of the principle is a rod held in the drill chuck and the end filed to a sharp point while the machine is running. In this case it serves merely as a pointer, and is suitable only for comparatively rough work because the drill chuck must be depended upon for the true running of the rod.

A cross-section of a simple form of ball-joint wiggler is shown in Fig. 1. It consists of a body *A* and the pointer *B*, the latter being driven into a hole in the ball *C*. The friction is provided by spring *D*, thrust washers *E* and the setscrew *F*. On account of the large friction surface between the ball and the body of the wiggler, trouble is sometimes experienced in making the pointer of this type run true. Fig. 2 shows an improved type with ball bearings. This type takes a little longer to make than the one previously described, but will pay for the extra trouble when first-class results are desired. By turning the knurled sleeve *A*, any required degree of friction can be set up. The higher the velocity of the revolving wiggler the tighter must the friction be in order to keep the pointer steady when it has been set true.



[In our opinion the device, shown in Fig. 2, fails of the intended result if this is to give the large ball a rolling contact with the shell in a direction transverse to its rotation. If the pointer be grasped with the fingers while the holder is rotating, and the pointer is in absolute alignment, the balls will naturally roll between the large ball and the container as in an ordinary ball bearing; but if the pointer be deflected, the oscillating movement will be opposed by sliding friction as certainly as if the ring of small balls were continuous rings of round-section wire.—EDITOR.]

Fig. 3 illustrates the method of aligning the spindle of the vertical milling machine with the center of the hole to be bored. At *A* is a jig clamped to the milling-machine table. The intersecting lines *B* have been laid out with the height gage. With the wiggler *C* held in a drill chuck in the machine spindle the sharp end of the pointer is trued up by holding a steel scale or other similar object against the side and near the end of the pointer while the machine is running. Only a second or so is required for this, and it is very easy to tell whether the friction needs adjustment, which is accomplished by turning the knurled sleeve as already described and illustrated.

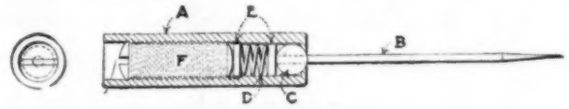


FIG. 1

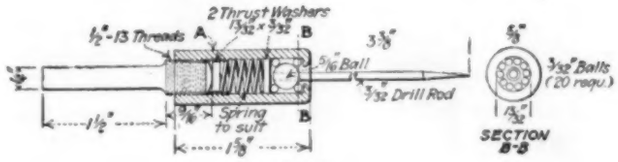


FIG. 2

FIGS. 1 AND 2. WIGGLERS WITH PLAIN AND BALL JOINTS

Now the pointer is brought approximately over the cross lines and almost touching them. A good magnifying glass is used when making the final adjustments. By holding an electric light opposite the pointer and glancing through the magnifying glass along the line, the sharp end of the pointer is brought exactly over the line. The same procedure is gone through with relation to the other line. The wiggler is now removed and the hole drilled, bored and reamed to size. Care should be taken to have the gibs of the milling machine tightened sufficiently before the alignment is made to prevent the table from moving under the strain of drilling and boring. When the end of the pointer is a perfect needle point and the locating is carefully done, tolerances of ± 0.002 in. can easily be maintained, provided the machine itself is in a fairly good condition.

The wiggler method is adapted to universal milling machines, boring mills and drilling machines. In the latter case the work has to be rapped into position and therefore not quite as accurate results are obtained.

Fig. 4 illustrates how a job that most toolmakers dread is made a comparatively simple operation by the wiggler method. There is much uncertainty when a job of boring hinge-pin holes in a jig is attempted, where the length and position of the hole makes it impractical to bore the entire length of the hole from one end. This uncertainty can be eliminated by using the wiggler. The jig lid *A* is secured to the body of the jig and pivoted by the two sections of a long hinge *B*. In order

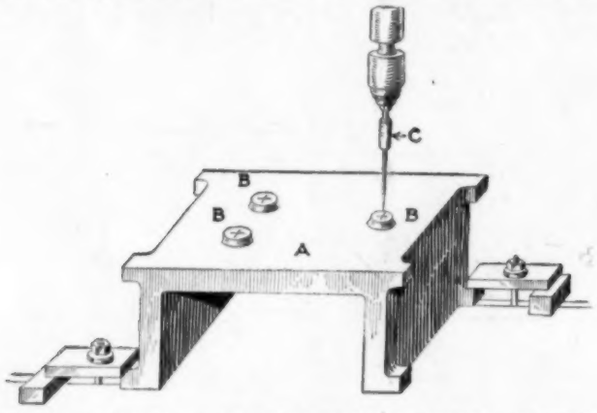


FIG. 3. ALIGNING A JIG FOR DRILLING HOLES IN COVER

to have it function properly it is essential that the holes for the hinge pins be in line and parallel to the bottom and side of the jig. After fitting the lid it is clamped to its permanent seat by the two clamp screws *C*, the back of the lid being held to correct elevation by blocks inserted between the body of the jig and the under side of the lid. One of these blocks is shown at *D*.

As an additional precaution the back of the lid is held down by a clamp when the jig is ready for boring. The center of the hinge-pin holes is located with the jig on a surface plate, the cross lines being scribed on both ends of the lid as shown at *E*. The layout lines

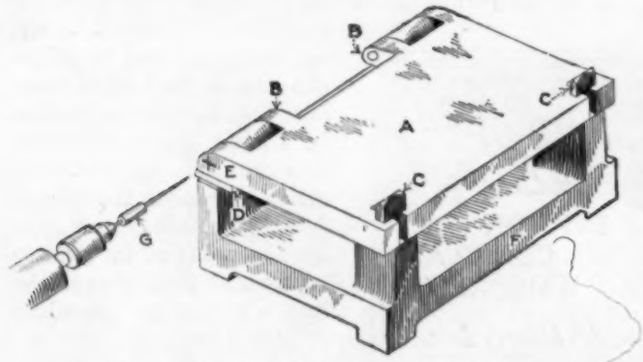


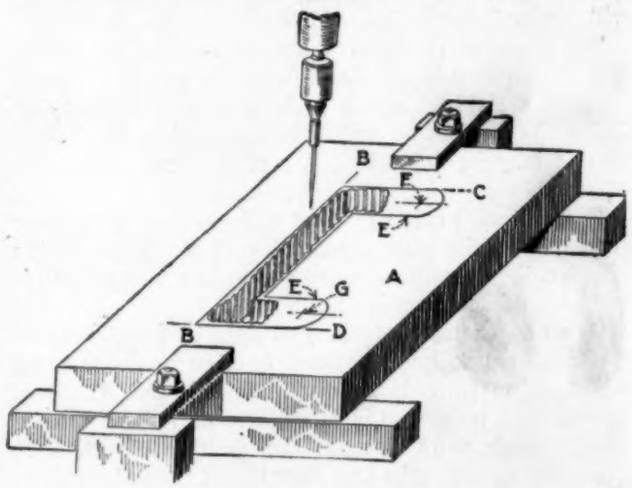
FIG. 4. LINING UP A HINGED-LID JIG

must be parallel to the bottom and the finished side *F* of the jig. The jig with lid in position is now clamped on the milling-machine table and the side *F* indicated parallel with the cross-slide of the machine. With the wiggler *G* in a drill chuck in the milling-machine spindle the exact center of the hinge-pin hole is now brought into alignment with the spindle as previously described.

The wiggler is now removed and the hole drilled, bored and reamed to size, after which the jig is reversed on the table, and the hole at the other end of the jig lid is treated in the same manner. The knee of the milling machine need not be disturbed for locating the other end, only the table traverse being used for lining up the vertical line. When the hinge-pins are inserted it will be found that they line up perfectly without any further "doctoring," which is often necessary when the hinge-pin holes have been bored by other methods.

Lining Up a Die for Machining

Fig. 5 illustrates a further use for the wiggler. In the sketch is shown the die blank *A*, the core of which has been drilled out, being lined up with the table traverse of the vertical milling machine preparatory to milling it to the layout line *B*. Any straight line in the die opening can be lined up very quickly by observing through the magnifying glass the relation of the wiggler pointer to the lay-out line at several points; if there appears any difference it is corrected by rap-



FG. 5. SETTING A DIE TO BE MILLED

ping the die blank. The wiggler need not be revolving when lining up work in this manner.

When the ends or any section of the die opening come at right angles to the layout line as shown at *C* and *D*, Fig. 5, the faces can also be machined at the same setting. Radii *E* of the die shown were produced by lining up the milling-machine spindle with the center of radii, in this instance represented by the cross lines *F* and *G*.

The Air Mail Service

During the month of August the air mail service between Washington, Philadelphia and New York was conducted without a miss, hitch or serious delay of any character. The operations for the month were perhaps the most remarkable in the history of aviation. There were 27 flying days, of which 108 legs of the journey had to be performed, and in that month there were but two forced landings, one with a delay of 7 min. and the other of less than 10 min. The total possible miles of flight were 11,961, of which 11,957 were completed. A total of 5679 lb. of mail was carried on the trips. A most rigid mechanical maintenance system on all fields was kept up, with the result that the month closed without a single plane of the 15 being laid up in the shop for repairs.

Extracts From Chordal's Letters

IN THIS article Chordal takes us back to boyhood days and vividly portrays the relationship between a youngster using man-sized tools in the shop and one using man-sized penholders in school and being expected to do things properly. He also propounds again a question asked many years ago, but never satisfactorily answered; illustrates a novel method that "Billy" invented for figuring the "efficiency" of the stroke of a loose piston that had run amuck into a brick wall; tells of an Englishman's troubles with our monetary system, and gives advice to Reeves on how to convert millimeters into inches by handing him a 15-mm. scale and telling him to "learn it" and to "think it."

MR. EDITOR:

* * * Speaking of Benny standing on a block by a vise bench years ago reminds me that that vise bench was the right height for Cooper, and the file was the right length for Cooper, and the file handle was the right size for Cooper's hand. But when it came to poor little Benny nothing was right except the height of the block, and I question if that was right, but he had to get up there some way. I wonder how long my dizzy head could stand it at a vise bench on a block that was not nailed down. I remember seeing at Cornell University an undersized boy looking on while a full-sized instructor in the shop was showing him just how to stand up at a vise bench and how to take hold of the file, and the aforesaid instructor was shoving that file nice and square across the job. And then he expected the little fellow to do it, but he would not fit. I believe too little consideration is given to instruction going over the head of the student in the physical sense.

* * * When I was a little fellow I used to go to school to Pop Rowe, and the picture on the back of the copybook showing how to hold the pen was just the picture of Pop Rowe's hand, and I never will forget it as long as I live. He would lean over me, with my thumb and three fingers in a bunch grasping the pen down where the ink was, and would say, "That is not the way to hold the pen; hold it this way!" And then he would show me, and he had the picture exactly. But the point was that that pen was suited to Pop Rowe's hand, or his hand, in centuries of handwriting, had become accustomed to that size of pen. But that pen was too big for me, and I would like to see the kind of a picture that would have been on the back of the copybook with my little hand holding Pop Rowe's big pen. Charlie just measured his brother Jimmie's fingers, and if Pop Rowe had tried to hold the pen according to the copybook, and the pen was as big proportionately for his hand as the ordinary pen would be for Jimmie's hand, then Pop Rowe would be trying to follow the copybook with a penholder about an inch and a half in diameter and with the pen sticking down about two and one-half inches from it. It is a wonder to me that I learned to write at all from Pop Rowe, and I am not sure that I did. Anyhow, the schools are not made for Cordy's size.

* * * That reminds me that a great many years ago I was sitting in your office and wished that some high-brow professor would give me a proper word, the opposite of momentum, for a thing at rest. You said, "Write out your question and drop it in that box over there," this box being on your desk. I wrote out the question and dropped it in the box over there and you printed the question. I do not think you printed the answers, but my recollection is that you showed them to me, and the purport of all of them was that a man that knew anything of mechanics or physics would not ask such fool questions. The question was, as I remember it: Inertia being the word used to express the indisposition of a moving body to come to rest, or of a body at rest to start into motion, and momentum being the word used to indicate the indisposition of a body in motion to come to rest or, in other words, one specific side of the inertia question, what is the proper word used to express the other side of the question, or the indisposition of a body at rest to start into motion. I don't believe any one of the professors pretended to answer my question, or to give me the simple word or to coin a simple word. These gentlemen went clear over my head with their explanations, but without the explanation, and I believe that about half the people in the world who think of the thing at all think of inertia as one side of the question, the indisposition to move.

* * * Years ago Bennett had a shop engine about eighteen inches bore, I think. One day the key took a notion to come out of the crosshead, and the piston shot through the cylinder head, taking the cylinder head with it, and the cylinder head went through a brick wall, and it just happened that I was standing near the engine when the thing occurred, and it just happened also that Benny Bennett, who was home from vacation at West Point, was standing there too. Benny was delighted and said: "The first money I ever earned was for firing up the boiler and I used to run the engine till near school time. I have seen this engine make a million strokes, I think, but that is the first one of them worth talking about." Benny, being an artillerist, don't take much stock in things that go back and forth in cylinders, but wants them to go out and do something.

* * * The shop of course had stopped, and every-

body was around looking at the wreck, and among others was Billy Reynolds, a young chap from the pattern shop. He and Benny had always been close friends, and Benny knew that Billy was a crank on efficiency and had read up on Harrington Emerson and Gilbreth, and he thought that Kent was great. Benny seized on Billy's view of things and said:

"Billy, can you figure up the efficiency of that stroke?"

"Sure," said Billy.

"How would you do it?"

"Why, figure up the cost of the stroke and then the value of the hole in the wall, and divide the hole by the stroke."

"That is all right, but how will you get at the value of the hole in the wall?"

"That is easy enough," said Billy, "figure the cost of producing the hole by other best-known methods. That will give it to you."

"But," said Billy, "there is another way, and that is to figure up the cost of repairing the hole. Either way you get the efficiency of that stroke of the engine, and it ought to figure out about the same either way."

* * * Reeves seemed to be in a peck of trouble the other night. He works down in the Miami Arsenal, where all the work is French—155-mm. carriages, I believe.

* * Mr. Crookshank, from Birmingham, England, was in my office and said he: "This is a mighty inconvenient money system you have. I can't tell which end I am standing on or what anything is worth. Before I started over I got the books and studied the American system of money, but nobody over here seems to understand a bit of it. No one knows what a mill is except an artillerist I talked to, and he said it was the sixty-four-hundreth part of a circle, and then most everybody I meet talks about nickels and quarters, and none of them know anything about eagles, and they talk about bucks. I found that by buck some of them meant a dollar and that others use the same word for ten dollars, and they point to the picture of the sawbuck or the X on a ten-dollar bill. I have the dollar business and the cent business down to a nicety, but in the end I have to figure the thing up in pounds, shillings and pence to see how much a thing is worth. I say it is very inconvenient, don't you know." I asked him why he couldn't forget it while he was over here, and take up his pounds, shillings and pence when he got home again.

* * * But to return to Reeves. He seems to be having quite a time with his millimeters and his conversions. I handed him a 15-mm. scale and suggested that he put it in his pocket and learn it, and think it, and think nothing else, and that when he went to the shop he gather up all of his scales with inches on them, and his 2-ft. rule, and take them home and lock them up and forget there was any such thing as an inch until after the war. He can get it back quick enough then.

CHORDAL.

Providing for the Army

To provide for the needs of the Army the construction division has undertaken, since April, 1917, a total of 323 operations, and now has in prospect 153 more. The total cost of this program is estimated to be $1,083,766,198. At the end of August 93 operations were completed, including the camps and cantonments. The cost of the finished operations was $277,745,847. Additions and alterations of minor character are not figured as "jobs." There are now under construction 266 jobs, which will represent a cost approximating $636,858,351. Practically all of the work now under construction will be finished by Jan. 1, 1919. However, some of the larger jobs, which are of a permanent nature, will not be completed until October, 1919. Included in the present construction are the development of eight port terminals at a cost of approximately $150,000,000. One of these, the Brooklyn Army supply base estimated to cost $40,000,000, will have the largest warehouses in the world. The other terminals in the course of construction are: South Boston, Mass., which is estimated to cost $28,000,000; New Orleans, La., $10,000,000; Charleston, S. C., $25,000,000; Norfolk, Va., $20,000,000; Philadelphia, Penn, $15,000,000; Newark, N. J., $10,000,000; Newport News, Va., about $5,000,000. Projects now under way include a large number of ammunition depots, quartermaster warehouses and storage depots in inland cities, hospitals, ordnance plants, new training camps and the enlarging of other camps to provide accommodations for the increasing army.

Rose Buys a Bond

By V. E. ATWELL

Said Carmina Fradetti to Rose Polichetti:
"Of ice cream and soda I know you are fond;
But by saving your money a little bit, honey,
Don't you think you could take just one Liberty bond?
We others are buying; that is, we are trying
To put our department 'way over the top;
But we'll need every penny; there'll be none too many,
And we can't pass by any who work in the shop."

Said Rose Polichetti: "Carmina Fradetti,
You're just an old Betty! Stop fussing around!
Of food conservation for saving the nation
I'm utterly weary and sick of the sound.
I'm earning good money; folks would think it was funny
If I wore last year's things or the year's before that;
Your talk you'll be stopping when I come back from shopping
With a pretty new gown and a big picture hat."

Said Carmina Fradetti to Rose Polichetti:
"These are days to put nonsense clean out of your head.
If those Huns win the battle they'll treat us like cattle,
And then all good women had better be dead.
Those Prussian commanders in France and in Flanders—
Oh, don't make me tell you the things they have done!
Your tone would soon alter if our soldiers should falter
And our country lie prone at the feet of the Hun."

Said Rose Polichetti: "Carmina Fradetti,
You can wind me like silk round your finger and thumb.
Though I hate all this slavin' and scrimpin' and savin',
I'd have worse things to bear if the Prussians should come.
I'll do my endeavor to keep them forever
Where they surely belong on their side of the pond.
Just tell the committee it would be a pity
Not to put my name down for a Liberty bond!"

Drilling Jigs Used in the Manufacture of Hosiery Machines

BY ROBERT MAWSON

Some of the interesting jigs used for machining members and parts of hosiery machines are here illustrated and described. The greater part of these jigs are simple in design, but may produce as equally accurate results as more complicated tools.

A PREVIOUS description detailed some of the operations and manufacturing processes on a few of the parts of the Banner knitting machines made by the Hemphill Manufacturing Co., Pawtucket, R. I. A great many special jigs and fixtures are used in building these machines, and some of the drilling jigs are here described.

These jigs are simple in design and produce results as accurate as more complicated tools. Positive stops are used for locating the parts which are placed on studs or pins that fit in previously machined holes. When drilling gears the teeth are employed as locating mediums to obtain the desired interchangeability.

This plant follows a system of subdividing operations. The advantages of this method are that the tools are simpler in design, the work does not call for high-grade help, and the upkeep of the tools is lower, since any repairs may be executed quickly and at a low cost.

The type of jig used for drilling the frames is shown in Fig. 1. In this jig the casting is placed on a cast-iron base or cradle, being held by means of a thumb nut and washer *A*. The jig plate is then placed over the frame and located by the pin *B*, which fits into a bushing on the cradle and is held in place by a latch which fits under the casting and is operated by means of the screw *C*. Twenty-nine holes are then drilled by the use of this jig. Other jig plates of similar design are employed for drilling holes on the other surfaces of the frame. Another type of jig used for holes on the periphery of circular parts is shown in Fig. 2. In this jig the casting is slid on a pin in the center of a jig and located by a stop against which a projection on the casting abuts. The open washer *A* is then placed under the head of a capscrew, and tightening this screw holds the casting in position on the jig. Nine No. 32 holes are drilled in this operation with the jig resting on the machine table.

Many of the smaller parts used on these machines call for one or more holes that must be in a certain relative position to other holes or surfaces. These results are obtained by a simple type of open jig, such as that illustrated in Fig. 3. This jig is for drilling a No. 55 hole in the end of the yarn lever, which is placed in the jig on a pin *A*, that fits in a hole previously machined. The clamp *B* is then tightened against the part by means of the knurled head screw *C*, thus holding the piece in position ready for drilling.

Another type of jig used when drilling two holes in the fashion wheel is shown in Fig. 4. These holes are

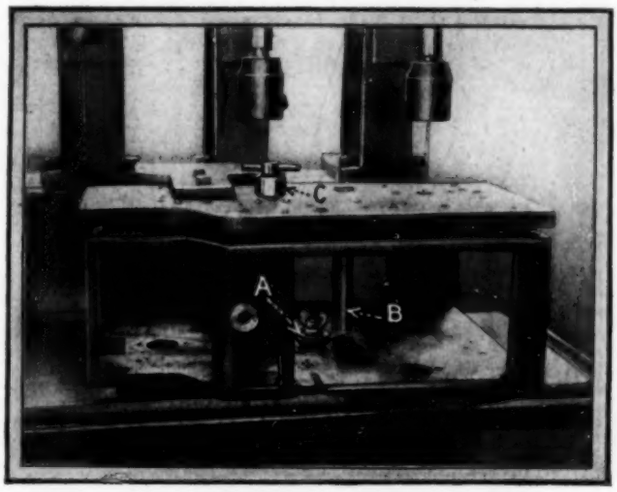
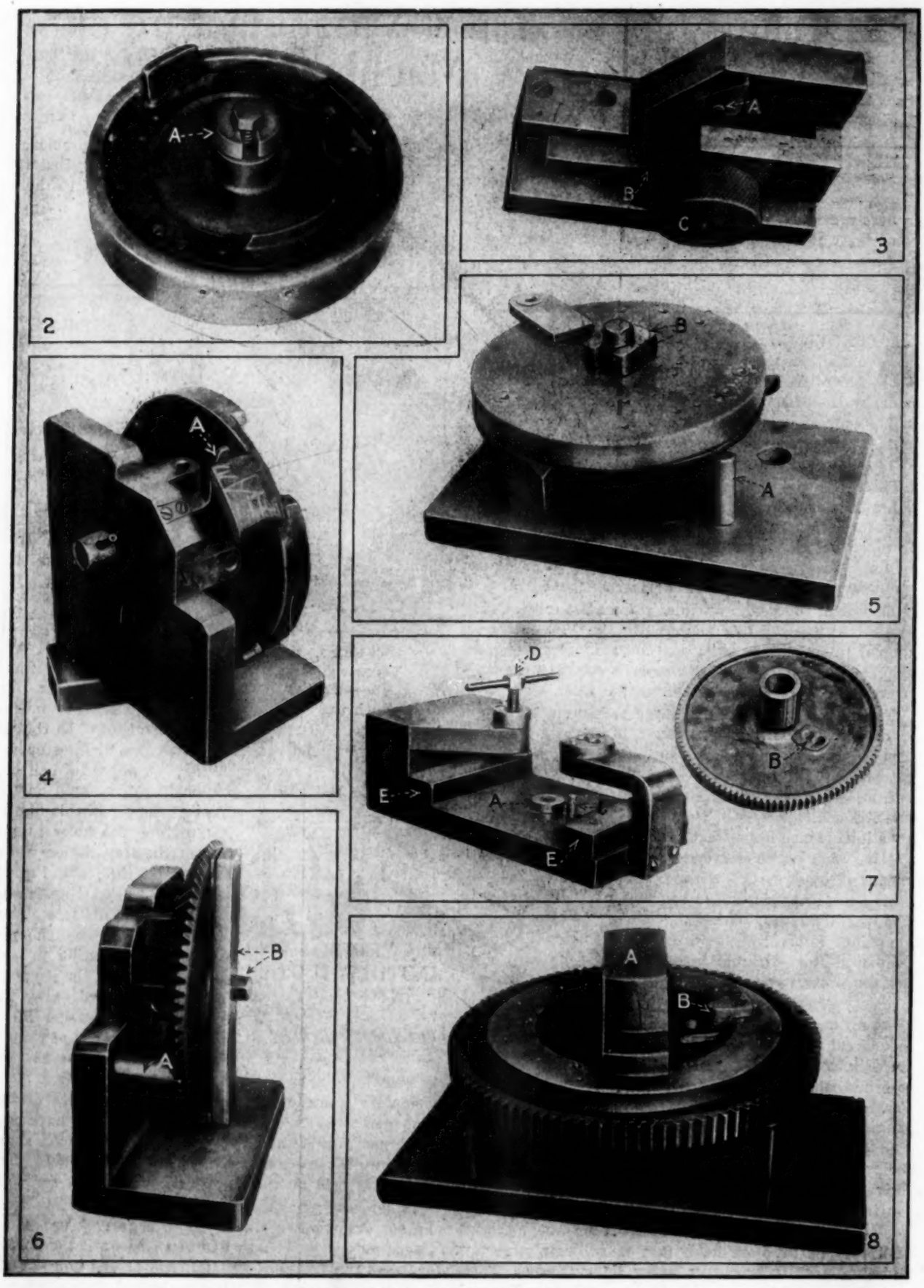


FIG. 1. DRILL JIG FOR THE FRAME

for $\frac{5}{16}$-in setscrews. The jig contains a center pin, upon which the casting is placed and located by means of the stop *A*. It has also a base, as shown, so that it will set firmly and squarely during the drilling operation. The jig is revolved 90 deg. in order to drill the second hole, the bushing for which will be seen on the front of the jig in this figure. For drilling the holes in the face of the stop-motion wheel a base and jig plate, Fig. 5, are used. The casting is slid on a pin which fits into a previously bored hole. The pin *A* locates the casting in correct position, and the jig plate is held on the casting by the screw and open washer *B*.

A similar method of centering a gear by a bored hole in a casting is shown in the jig illustrated in Fig. 6. Provision for locating the gear is made by means of two pins one, of which is shown at *A*. These pins have been machined so that their outer ends are the correct shape to fit into the space between the teeth of the gear. The casting is held on the jig by the clamp and screw *B*. Another way of locating a casting, Fig. 7, is by a jig for drilling two $\frac{1}{2}$-in. holes in a gear. The gear is placed on the jig boss *A* and revolved until the spring-operated pin *C* comes through one of the holes in the web *B*. The screw *D*, when tightened, holds the part firmly in position. The special pads *E* are provided as rests for the rim of the gear.



FIGS. 2 TO 8. VARIOUS DRILL JIGS

Fig. 2—Drill jig for fashion wheel. Fig. 3—Drilling jig for yarn lever. Fig. 4—Jig for drilling screw holes in wheel. Fig. 5—Faceplate jig for stop-motion wheel. Fig. 6—Jig for drilling bevel gear. Fig. 7—Jig for drilling holes in gear. Fig. 8—Easily handled jig

The holes in the face of this same gear are drilled by a flat-face jig plate, Fig. 8, which is provided with a handle *A* to facilitate its manipulation. When placing this jig on the work it is located by a pin on the projection *B* which fits into one of the holes shown in the gear drilled in the previous operation. This gear is used on two types of machines with different drilling; both sets of drill holes are provided in this jig plate and suitably marked to guide the operator.

When drilling the quill gear the box-type jig shown in Fig. 9 is used. The gear which has been machine-bored and the teeth cut is slid into the jig being located by the two pins *A* fitting between teeth. Before actual contact has been made with these pins the knurled-head pin *B* has been slipped into a slot in the small end of the quill and by it turned to a certain position in the jig; this assures that the two holes drilled in this sleeve shall be in the correct position. The screw *C* holds the casting in firm position.

A disassembled view of this jig may be observed in Fig. 10 which shows the details of the casting, jig and parts.

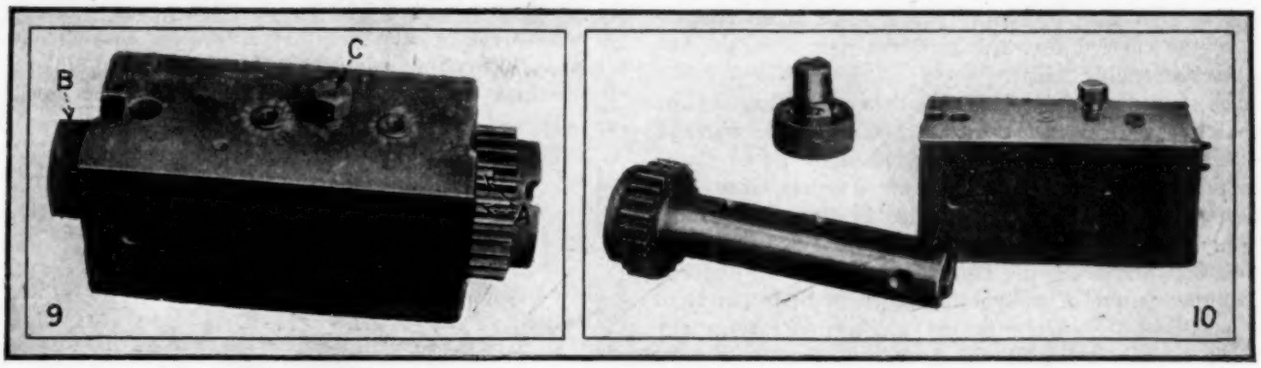


FIG. 9. BOX JIG AND THE WORK

FIG. 10. BOX JIG AND THE WORK

The Training of Women as Machine Operators

BY J. V. HUNTER

The experience of the management of the Computing and Recording Machine Co., of Dayton, Ohio, in the management of its women operators engaged in munition work antedates 1917. Consequently the problems arising from training women to do accurate machining had ample opportunity for solution before the nation became involved in the war. The methods evolved by this company therefore should be valuable to other American manufacturers who contemplate introducing female help in their factories to meet the present labor crisis.

In 1915 the company began work on British time fuses, and circumstances at that time induced the officials to start upon the special training of women. That the experiment proved successful may be judged from the 2200 women now employed in manufacturing the United States shell time fuses and the constantly increasing number being trained. The character of the work ranges from the most complicated screw-machine operation to delicate gaging for inspection.

The chief element in its success in handling women operators lies possibly in the policy that none shall be sent into the shop for actual production work until they have received a thorough test in the training school.

The methods of this concern incorporate an unusual system for the employment of women, as by this method no departmental foreman has the right either to hire or to discharge a woman worker. In fact it is said that none of the employees are ever discharged.

When a shortage of female help occurs in any department the foreman of that department puts in a requisition stating the number of workers he requires and the operation for which each is wanted. The employment department then engages the women and sends them to the foreman of the training school with instructions regarding the operations for which they are wanted and for which they will be trained. The standing rule here goes into effect that none shall be sent into the shop until adequately trained to thoroughly qualify them for their new work.

The training course is intensive in the extreme, since the work in the shop operations has been subdivided, as far as possible, to simple-operating machines, and it is the training school's endeavor to qualify the girls for their work in courses of one to three weeks, the latter being for the more complicated operations.

A visitor is surprised on seeing so small a training school which it is necessary to maintain for so large a working force. The room employed for this purpose is 50 ft. wide by 60 long, but in it is at least one, rarely more, of every machine in the shop arranged for each individual operation required to complete a time fuse. In other words, every time-fuse operation is represented, so that the school could actually produce completed time fuses.

This institution is in charge of a male foreman, the only man in the school. Under his direction are a competently trained corps of women instructors, so that each cares for no more than six girls.

The reason why only women are used as teachers is rather a psychological one, for the new girl naturally thinks: "If that woman can do it then I can learn to

do it just as well." This might be different were the teachers men, and the novice would be confused in attempting what she considered had been only a man's job.

As the assignment of each girl covers only one operation it is the duty of the instructor to teach her solely those motions which will be required for efficiently performing that piece of work. This method of instruction is rapidly carried forward until the new employee becomes reasonably adept.

The student is not required to learn machine set-ups (that is cared for in the shops by skilled male machine tenders); her sole energies are devoted to the mechanical movements of operation, and the necessary test gaging to know that the product is coming out uniformly.

Women who are being trained for inspectors undergo a similar course of instruction to train their hands to be adept and accurate in the gaging operations for which they are being fitted.

The training period finished, the student is transferred to the shop department the requisition of which she is trained to fill. By that time the newness of everything in connection with machine handling has worn off, and she no longer feels self-conscious and awkward when she joins the producing squad.

Wages of Women

When a woman goes into the shop she receives a minimum guarantee of 20c. an hour. There is no piecework, although an increasing bonus is paid, depending upon the quantity produced beyond a certain number. At the end of six weeks the new operator automatically receives a rate increase of several cents an hour.

Should her work continue to improve satisfactorily, at the end of six weeks she receives another increase. However, should her work not warrant this second increase she is not left in the dark as to the reason. Previous to the end of the period a woman instructor is sent to her, who carefully explains her deficiencies and endeavors to aid the operator in improving her work. As soon as her work is on a satisfactory basis she receives the increase, and from then on further increases are given as the improvement warrants. All bonuses for output are paid as direct additions to an operator's rate of pay and are not dependent upon it.

Should a foreman continually have trouble with an operator from spoiled work, careless handling or damaged tools, he may report it to the employment supervisor, who will have the case investigated. This may result in returning the girl to the school for additional instruction, or returning her to be trained for some other class of work for which she may be better fitted. Similarly the foreman will report any flagrant violations of discipline to the employment manager, who will take the necessary steps to correct them.

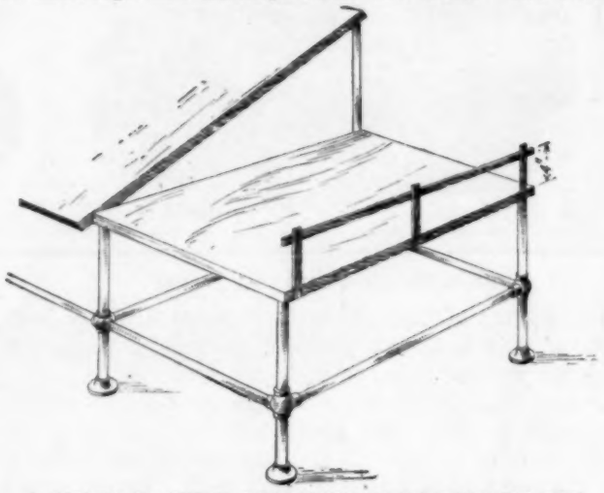
Should a woman come to dislike the class of work for which she has been trained she may after a period of six months apply for a change, specifying the class of work she desires, and when an opening occurs in that line she gets the first opportunity to enter the school to fit her for the new class of work.

Aside from this interesting training course one is favorably impressed with the intelligent and conscientious manner with which all the women in this shop are working. The general cleanliness of the shop and workers is equally remarkable, as all the workers seem to be able to handle their jobs without having their clothes and surroundings covered with grime.

Guard for Drawing Table

By Nathan L. Goldberg

The illustration shows a simple means for eliminating a source of continual annoyance due to the rolling off of drawings and tracings from the table. The stock



A GUARD TO KEEP DRAWINGS FROM ROLLING OFF THE TABLE

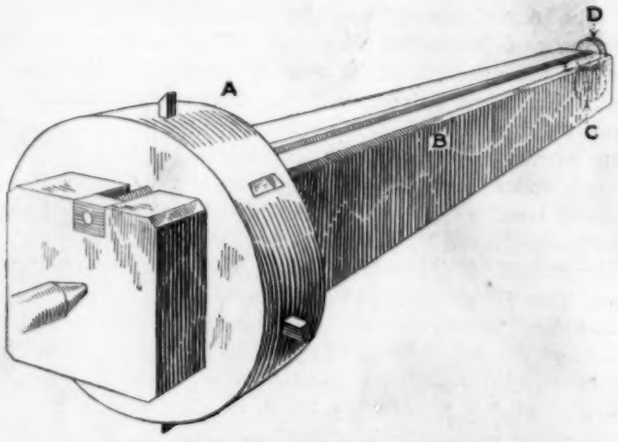
used was 1-in. oak strips fastened by countersunk wooden screws with their points filed flush with wood in order to prevent anything catching on them.

Boring Bar for Torpedo Tubes

By F. T. Schell

The illustration shows a boring bar that is used for boring torpedo tubes, the sections of which are 18 ft. long by 21 in. in diameter. The tolerance is 0.010 in.

The bar is square, is 20 ft. long and turns between centers. The ring *A* which holds the cutters slides back



BAR FOR BORING TORPEDO TUBES

and forth on the bar and is controlled by the screw shown in the dotted outline at *B*. The gear at *C* is secured on the tailstock center and meshes with gear *D*, which is keyed to the screw. There are six cutters in this bar and the time for boring one of these tubes is 12 hours.

Training Men and Boys in a Shop School

By A. N. HOOK
Head Instructor Norton Grinding Co.

The problem of training men and boys to fill the ranks of the shop has in many cases developed into the establishment of training schools with a standing of a regular shop department, the education of the new members of the force being accomplished under conditions and environment most favorable to that end and least likely to interfere with the routine of the shop. In this article the head instructor of such a school outlines the methods by which he has been able successfully to graduate a large number of workmen and at the same time lessen the financial burden of the school's maintenance.

ONE of the first problems to be solved by the shop training-school instructor after it is definitely known what his equipment is to be is to select from the regular product of the shop such work as will be suitable not only for the equipment but to the capabilities of the students. To this end he should devote considerable time visiting the various departments of the shop, consulting with the foremen as to the class of work that can most advantageously be supplied, that will be least susceptible to spoilage from inexperienced handling and that will best serve to hold the student's interest. There is generally considerable work in a shop that lends itself readily to school work.

The first equipment of the Norton Grinding Co.'s school comprised three lathes, one vertical and one horizontal No. 3 Brown & Sharpe milling machine, one speed lathe, one hand-milling machine, one 16-in. shaping machine, one tool-grinding machine, one 28-in. Cincinnati drilling machine, one two-spindle sensitive drilling machine, one arbor press and approximately 60 lin.ft. of work bench with eight vises. There were eight students and the staff consisted of the chief instructor and an assistant when the school started.

As we had few expensive small tools, such as large drills, reamers, cutters, etc., it was necessary at first to eliminate all work requiring them and also to lay plans for a stock of small tools that could be made by the students, including bolts, mandrels, arbors, center-shanks for shell milling cutters and drill chucks, sizing plugs, spacing collars, die holders, counterbores, reamers, plain and inserted tooth milling cutters, end mills, V-blocks, parallels, chisels, screwdrivers and the numberless other tools of every description that make up the equipment of the tool crib.

An hour each day spent in going through the shop resulted in bringing in all the work that could be handled, which comprised short shafts, studs, bushings, pulleys, levers, cones and brackets, and jobs of splining, key fitting, trimming and light assembling. As the proficiency of the students increased, our toolroom foreman supplied quantities of jig bushings, knurled-head screws, etc., to make, and also sent in minor tool-repair jobs.

A No. 1 Norton universal tool-grinding machine was added to our equipment and the more advanced students were given instruction in plain cylindrical and surface grinding as well as tool sharpening. All milling cutters and similar tools borrowed from other departments were put in good shape before returning them, blades for inserted tooth cutters were fitted, and limit gages, both plug and flat, were ground.

It is very necessary for the instructor to acquire at the outset an idea as to a prospective student's mental capacity and the nature and extent of such education as he may possess. To this end each student is given a preliminary examination in mathematics, especially in relation to common and decimal fractions. Care is taken by the instructor to avoid creating the impression that he is trying to find out how little the student knows about figures; instead he tries to convey the idea that because he might be out of practice owing to his being away a long time from school without opportunity to exercise his arithmetical knowledge it will have no bearing upon his standing and development. The main thing is to discover whether or not the student is capable of developing the necessary mental ability to handle the work for which he is to be trained.

He is then given instruction in the uses of the various tools, starting with the simpler forms such as laying out circles with prick punch and dividers; laying off distances with scale, square and scriber, etc. He is taught to set inside and outside calipers to scale, judging sizes by the sense of touch, and later to handle the micrometer on plug gages, reamers, cutters and other similar work.

Following this comes instruction in shaping cutting tools such as right and left hand diamond points, facing tools, round-nose and threading tools. The student is given a model and some pieces of $\frac{3}{4}$-in. square by 3-in. cold-rolled steel with suitable information as to methods, and is cautioned against the dangers of the grinding wheel, after which he is left to himself for a while, but is kept under close observation, being advised and corrected by the instructor when necessary.

The application and determination of the student can be gaged to some extent in this work, and after a brief period of unobtrusive observation he can usually be given a piece of tool steel and entrusted to make a real tool with which he is started on lathe work.

The reason for starting the beginner on the lathe is that this is the most commonly known of machine tools,

and rarely does one find a student who has not some knowledge of its function; therefore the fact of his being at work upon something that is definitely connected in his mind with the machine shop helps to stimulate his interest, and this is a very desirable frame of mind to have the student in.

As the student develops proficiency in this work and shows himself capable of learning the principles involved, he is shifted to other machines, and by thus changing him about from one machine to another and to jobs requiring increasingly skillful treatment, he acquires the habit of becoming quickly acquainted with his surroundings, he is kept alert and mentally adaptable so that when eventually transferred to the shop he will be able to take up his new duties with ease and facility.

The instructor should keep close watch upon his students in order to discover peculiarities that would indicate special adaptability to certain lines. If the latter should ask for more time upon the lathe or the milling machine and should show special interest and proficiency in this direction it would be well to develop his skill in these lines.

It should be borne in mind, however, that keeping the student too long upon repetition work, that is, where he is producing the same piece over and over again, will tend to give him the impression that he is being "used" as a money maker, therefore he should be kept upon such work only so long as is necessary to be sure that he has learned all the lessons that the piece can teach.

Instructions in the use of tools and machines, oiling, adjusting, etc., are frequently given, and care should be taken that the student should at all times keep his equipment in perfect order, and he should not be allowed to work under improper conditions.

Foremen from the shop departments are encouraged to visit the school, not only to get an idea of what the students are doing but when they see what is being done they can usually find some work in their respective departments that is adaptable to the class work. Foremen are also able to pick men that appear especially fitted for certain jobs, and these men can then be trained with special reference to these jobs.

One feature of our school that has been of great value to us is the facility with which we can temporarily fill the positions of men that are absent through sickness or other causes. The student usually welcomes the opportunity to go into the shop and prove his worth in this way. In case of a rush of work also the more advanced students may be trusted to tide over the situation and "catch up" the department to the satisfaction of all concerned.

Sometimes, on the other hand, foremen will send men from the shop into the school in cases of temporary slackness. Not infrequently the instructor upon his visits to the shop is stopped by one or more of the men and asked to be allowed to spend a few days in the school. To avoid friction, this matter is always taken up with the foreman in charge and in this way better understanding is developed and the special inclinations of the men discovered and taken advantage of.

The visits of the instructor to the shop should be made two or three times a day with a friendly greeting to the foremen and the men. He should show evidence of his interest in the welfare and progress of his former students and everywhere endeavor to break up the monotony of the daily toil with a cheerful word of appreciation here and there, creating the impression among them that "someone seems to be interested in me and what I am doing."

There will be individual cases, of course, where the instructor's work will not be appreciated, and side remarks about "cheapening of labor," etc., will be heard, but these are for the most part from the chronic grouches whose number is comparatively small, and even they, if treated with tact and diplomacy, may be roused to interest and converted into useful and appreciative members of the force. Approach the men with a story of some particular ex-student who is "making good" in his department, mentioning names and cases without hesitation, and nine times out of ten, if correctly applied, this method will result in noticeable improvement.

As the instructor becomes more familiar with the school, with the men and with the needs of the shop, the equipment can be augmented and the scope of the school extended. The position requires patience, tact and careful study of human nature.

Our school has been enlarged by the addition of more machinery and work benches, and we now have 46 men in training, with a staff of seven instructors. Our men comprise various classes —boys of 16 just out of school, men educated in foreign countries, and men not educated at all. Many of them come from jobs not calculated to inspire mental effort, such as barbers, painters, paper hangers, chauffeurs, firemen, masons' helpers, teamsters, motormen, waiters, etc. They are all given a brief talk about the value of the trade and the importance of being thorough in their efforts, and impressed with the fact that to dodge any part of the course will lessen their chances for success.

Our regular course is eight weeks, as follows: Milling, 2 weeks; drilling, 1 week; lathe work, 3 weeks; grinding, 1 week; bench work and assembling, 1 week.

It is of course not necessary to follow out this sequence exactly as each individual case must be administered according to the circumstances and conditions of the work needed and machines available as well as in reference to the students' requirements.

Milling work involves the use of face mills, formed cutters, end mills and saws, and includes keyseating, milling in jigs, set-ups (using bolts and straps), holding work in vise and on index centers, and gear cutting.

Drilling work consists of size drilling, tap drilling, drilling for dowels, machine tapping, reaming, counterboring, facing and jig drilling, as well as various methods of setting up with straps and bolts, vise, etc.

Lathe work includes straight and taper turning, squar-

ing, facing, filleting, with work on centers and on mandrels; chucking, boring and reaming; inside and outside threading, both V and Acme form of thread; use of steadyrest, recentering, etc., and also involves the forming and grinding of tools for these operations.

On the grinding machine the student is taught to grind cylindrical surfaces both inside and outside, to face up shoulders, to set up work in the chuck and on the table; to grind flat surfaces, to grind gages, cutters, reamers and other tools.

When the bench-work course is reached the student is instructed in the use of the file, the hammer and chisel, and taught to use taps, reamers and scrapers properly. Several styles of our smaller machines are machined and assembled complete in the school, which involves the use of all tools as above as well as the operations of babbitting and fitting spindles, bearings, caps, etc., putting in oil felts and wicking, setting studs, putting on oil cups, and the innumerable minor operations that make up a complete machine.

Testing the Relative Merits of Casehardening Materials

BY CHARLES N. UNDERWOOD

The following is a description of the method employed by the Remington Typewriter Works to determine the qualities of casehardening materials. It consists in casehardening test pieces of steel with the various materials to be tested and of measuring the results. In order to more adequately describe the process the details of a comparative test of granulated bone and a mixture of hardwood charcoal and potassium ferrocyanide are given.

CASEHARDENING is employed for producing a hard crust, or shell, about a piece of soft steel which is low in carbon content. The first part of the operation consists in carburizing the steel shell and the second in hardening this carburized shell by quenching when at a high heat. As the quenching element can be easily controlled and kept constant by means of the pyrometer the value of the casehardening material must lie in its ability to give up its carbon to the steel. It is this ability to give up carbon that we must measure in making comparative tests of casehardening materials. In other words we want to know which material will give the deepest, densest and most uniform case under constant conditions of time, temperature, packing and quenching.

TABLE I. TEMPERATURE LOG

Time	Temperature	Remarks
8:30	1,600 Deg. F.	Boxes in Furnace 8:14
9:01	1,820	
9:20	1,780	Oil reduced 9:15
9:30	1,730	
10:04	1,690	
10:30	1,660	
11:12	1,610	
11:30	1,620	
12:00	1,580	
12:14	1,600	Pcs. 19, 11, 13, 33 removed
1:03	1,620	
1:30	1,590	
2:00	1,610	
2:13	1,640	Pcs. 30, 5, 1, 12 removed
2:30	1,610	
3:00	1,630	
3:32	1,610	
4:01	1,620	
4:11	1,620	Pcs. 40, 16, 32, 28 removed

A bar of round, bright machine-screw steel $1\frac{1}{16}$ in. in diameter was obtained from the stockroom and cut into pieces each $3\frac{1}{4}$ in. long. Each piece was given a serial number which was stamped on both ends in order that it could be readily identified. Analysis of the steel showed the following: Phosphorus, 0.598 per cent.; manganese, 0.094 per cent.; sulphur, 0.098 per cent.; silicon, 0.010 per cent.; carbon, 0.100 per cent.

The boxes in which the test pieces were packed were of cast iron and their dimensions were $6\frac{1}{4}$ in. by $4\frac{1}{4}$ in. by $3\frac{1}{4}$ in. Two pieces were packed in each box and were placed as nearly as possible in the center. The box was completely filled with the casehardening material and the cover sealed with fire clay. Three boxes were packed with each kind of casehardening material. The first three boxes were packed with the charcoal mixture and placed on the floor in front of the furnace side by side. The next three boxes were packed with granulated bone and placed in a row in front of the first three. The door of the furnace was opened and the boxes placed therein in the same relative position.

A record such as shown in Fig. 1 was made to show the relative position of each box in the furnace as well as the test pieces in each and the kind of casehardening material in which it was packed. By means of this arrangement it was possible to remove one box packed with each kind of casehardening material by removing one row from front to back. One row was removed from the furnace after four hours, one row after six hours and one row after eight hours. As each box was removed the test pieces were taken out and quenched in cold water and the test numbers checked against the sketch to insure the accuracy of the record.

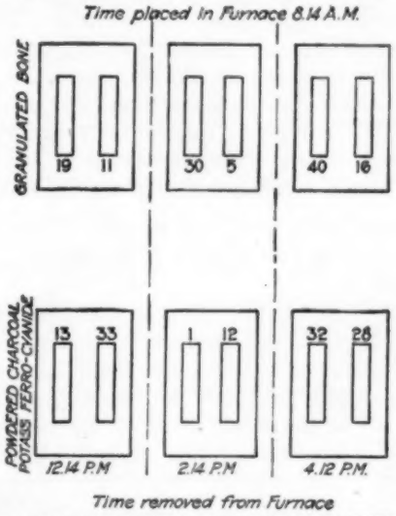


FIG. 1. RELATIVE POSITIONS OF BOXES IN THE FURNACE

A log of the furnace temperature was kept throughout

the test. The temperatures were obtained by means of a pyrometer the couple of which was inserted through a hole in the door and reached to approximately the center of the furnace.

In Table I is given the temperature log. It will be noticed that after the specimens were placed in the furnace the temperature was raised until it reached 1800 deg. F., about an hour later. The temperature was then cut down to and held at approximately 1600 deg. F. As the furnace was of the oil-burning type

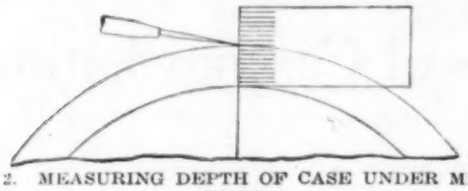


FIG. 2. MEASURING DEPTH OF CASE UNDER MICROSCOPE

the temperature was regulated by adjusting the oil burner.

After hardening, the test pieces were taken to the grinding room and a groove was ground through the case completely around the circumference at about the center of the piece. The pieces were then sawed into two parts at the groove. One-half of each piece was then selected and the cut end was ground flat and

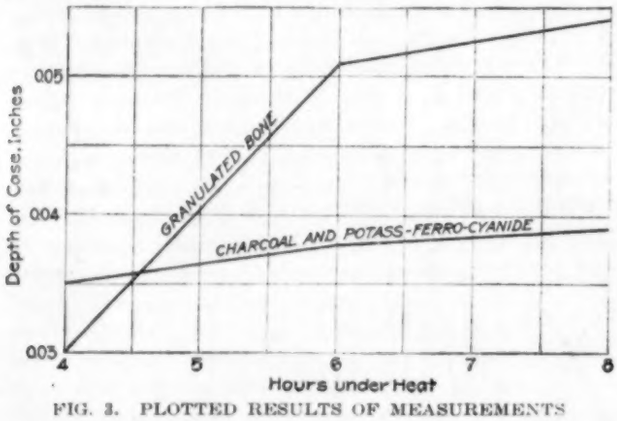


FIG. 3. PLOTTED RESULTS OF MEASUREMENTS

highly polished with very fine emery. These polished surfaces were then etched with a 20 per cent. solution of nitric acid.

Two lines perpendicular to one another were then scribed on this polished surface by means of a fine needle set in a steel holder. The depth of these lines to a certain extent indicated the hardness of the case, besides serving as the points at which we would measure its depth. The pieces were then ready for examination.

depth of case was as follows: A thin celluloid scale was made by ruling on it a number of hair lines 0.004 in. apart with a precision ruling machine. The edge of this scale was laid along one of the diameters scribed on the piece and the number of divisions between the uniform case and the edge of the piece counted under the microscope, Fig. 2. This is called the minimum case on the data sheet. The scale was then moved to the extreme inside edge of the case and the number of divisions between this point and the edge of the piece gave the so-called maximum case. The average of these two readings constitutes the mean depth of the case. The average of the mean readings for the four diameters was taken as the depth of the case for a given

TABLE II. RECORD OF EXAMINATION

Piece No.	Depth of Case Scale Divisions Max.	Min.	Mean	Remarks
1	9	7	8	Fairly uniform case, well hardened
	9	5	7	
	11	7	9	
	11	8	9.5	
	Average, 8.4			
5	10	6	8	Very uniform case, well hardened
	11	8	9.5	
	13	7	10	
	13	9	11	
	Average, 9.6			
11	8	6	7	Fairly uniform case, well hardened
	8	6	7	
	9	6	7.5	
	10	8	9	
	Average, 7.6			
12	12	9	10.5	Uniform case, well hardened
	11	8	9.5	
	12	9	10.5	
	15	9	12	
	Average, 10.6			
13	8	6	7	Fairly uniform case, very well hardened
	9	7	8	
	10	7	8.5	
	9	7	8	
	Average, 7.9			
16	16	12	14	Uniform case fairly well hardened
	17	14	15.5	
	20	13	16.5	
	15	10	12.5	
	Average, 14.6			
19	11	8	9.5	Variable case, well hardened
	8	6	7	
	7	5	6	
	9	5	7	
	Average, 7.4			
28	9	7	8	Variable case, poorly hardened
	12	7	9.5	
	14	9	11.5	
	15	10	12.5	
	Average, 10.4			
30	19	17	18	Fairly uniform case, well hardened
	19	12	15.5	
	17	13	15	
	17	12	14.5	
	Average, 15.8			
32	9	6	7.5	Variable case, fairly well hardened
	17	9	13.0	
	12	8	10.0	
	6	4	5.0	
	Average, 8.9			
33	10	8	9	Uniform case, well hardened
	11	9	10	
	12	8	10	
	11	7	9	
	Average, 9.5			
40	13	10	11.5	Uniform case, fairly well hardened
	13	9	11	
	14	11	12.5	
	16	12	14	
	Average, 12.3			

TABLE III. DEPTH OF CASE

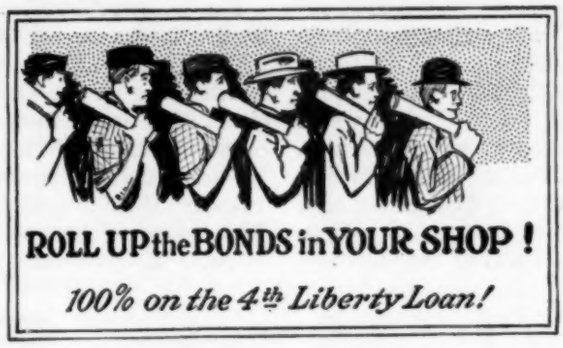
Material: Granulated Bone — Powdered Charcoal ..... 94.3%; Potassium Ferro-Cyanide 5.7%

Furnace Hours	4		6		8		4		6		8	
Piece No.	19	11	30	5	40	16	13	33	1	12	32	28
Depth of case.. Divisions..	7.4	7.6	15.8	9.6	12.3	14.6	7.9	9.5	8.4	10.6	8.9	10.4
Inches.....	0.0295	0.0305	0.063	0.0385	0.049	0.0585	0.0315	0.038	0.0335	0.0425	0.0355	0.0415
Average....	0.030		0.051		0.054		0.035		0.038		0.039	

In Table II we have the record of the examination of the test pieces. The data form was first prepared and the pieces were examined in the order in which they were picked up by the observer. Each piece was placed under a microscope having a power of 22 diameters, and the depth of the case measured at the four ends of the scribed lines. The methods of measuring the piece. In determining just where the case begins quite a little care must be observed. The marks left by the polishing wheel and the character of the scribed lines help considerably in determining these points as well as the color and luster of the polished surface.

In Table III are shown the results obtained by measuring the 12 test pieces as described above. Under the

heading of each kind of material used are given the case depths formed on the pieces for each duration of heat. The mean depth of case is given in both scale divisions and in inches. The results obtained from the two test pieces hardened together are averaged, and this average taken as being the average case to be expected from the conditions under which they were hardened. In Fig. 3 we have these points plotted on cross-section paper. As we have but three points to plot, these points have been simply joined by straight lines.



While these will not necessarily give the true curve of hardening they indicate the general direction of the true curves and suffice to compare the values of the materials in question. The deepest case after four hours of heating was with the use of the charcoal and potassium ferrocyanide; but after six and eight hours of heating the granulated bone gave a much deeper case than did the charcoal mixture. It will be noticed also that in both cases, after a six-hour heat, the case was at almost its greatest depth. In the case of the granulated bone two hours more of heating gave only an additional 0.003 in. of case, or an increase of about 6 per cent. In the case of the charcoal mixture only 0.001 in. of case was added by the two hours additional heat. This increase is only 2.6 per cent. of the depth produced by the six-hour heat. It would seem from this that the economical heat for hardening with both these materials was six hours. The result of this test indicates that granulated bone is a better casehardening material than a mixture of 94.3-per-cent. charcoal and 5.7-per-cent. potassium ferrocyanide.

The Relation of Screw-Thread Angles to Other Functions

By H. J. BINGHAM POWELL

Member of the American Society of Civil Engineers, Member of the Institute of Civil Engineers, Member of the Institute of Mechanical Engineers

In the discussion relative to the adoption of an international standard for screw threads the advocates of different angles for their slope and different forms for their roots and crests all have seemingly good reasons for their opinions. In this article the author sets forth his reasons for advocating the adoption as an international standard one of the types now in use.

IN CONNECTION with a proposed international form of screw thread a study of the conditions involved in selecting a given thread angle is necessary. In the United States and for the international type, 60 deg. has been chosen, apparently because it is a convenient form to lay out in the drawing office and incidentally because it has simple geometrical and trigonometrical functions. In the British empire the Whitworth form with the angle of 55 deg. is used (except in Canada, where the influence of the neighboring country is felt in imported machinery and tools, and the 60-deg. thread is often used), as laid down by Sir Joseph Whitworth many years ago. It is understood that that great mechanician adopted the angle in question because he found it to be the average in common use in the country for screw work. The rounding at the crest and root (which is fixed to have a radius of 0.1373 multiplied by the lead of the screw) was probably chosen in the same way. Later on it will be shown that this radius of rounding is a very practical and natural one. In the British empire and on the continent of Europe the British Association thread of 47½ deg. is used for fine screws such as those employed in instruments and watches.

Returning to the Whitworth form of thread, as it is an average of the various types that were in existence when Sir Joseph went into the matter of standardization, it probably has certain inherent advantages from the fact that if different workshops are independently making screws they probably choose forms that can most easily be made in a commercial way without undue wear of tools and consequent loss. It would seem that such traditional types going back for many years have been adopted for their inherent advantages. For instance, the standard gage of railroads of 4 ft. 8½ in. was fixed upon by Stephenson because it was the average width betwen the rails of the colliery tracks for trucks hauled by horses then in existence, and going back still further ancient wheel-track marks in old roads in England and in excavated Roman cities have also been found to be of the same width.

TABLE II.

LENGTH OF ENGAGEMENT ON FLANKS	
60 deg. screw	100
55 deg. screw	106
47½ deg. screw	118
45 deg. screw	121
DEPTH OF AREA AVAILABLE AT THE ROOT FOR TOLERANCE OF ROOT DIAMETER	
60 deg. screw	100
55 deg. screw	117
47½ deg. screw	149
45 deg. screw	161
DEPTH OF THREAD	
60 deg. screw	100
55 deg. screw	105
47½ deg. screw	120
45 deg. screw	125
CORRECTION TO PITCH DIAMETER NECESSARY FOR ANY ERROR IN THE LEAD	
60 deg. screw	100
55 deg. screw	110
47½ deg. screw	131
45 deg. screw	143

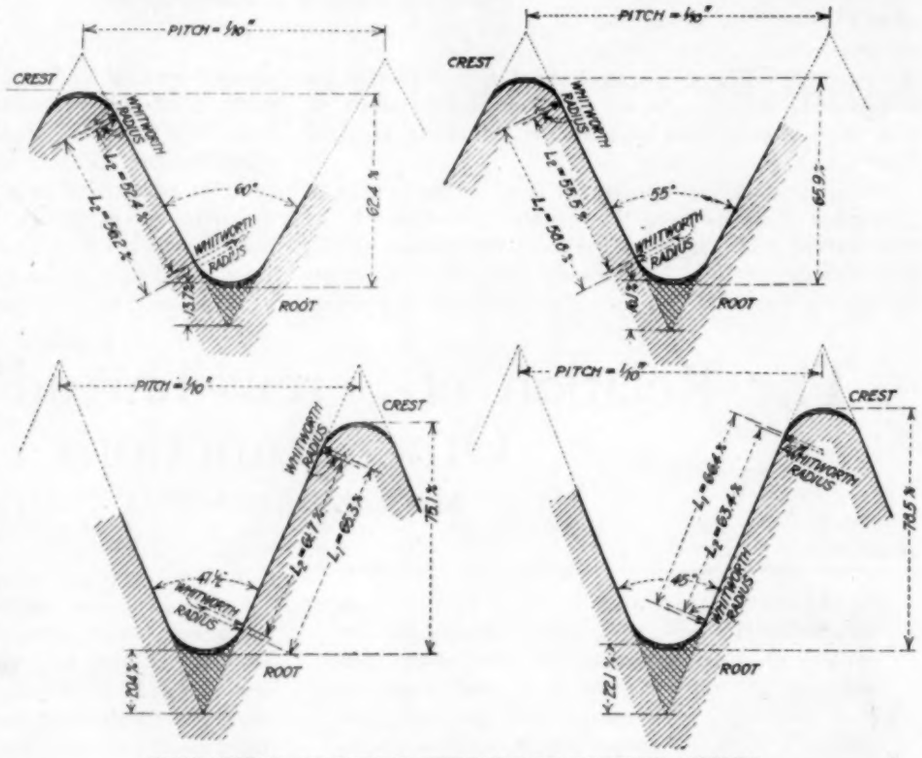
The radius of the Whitworth screw certainly comes under the designation of a "natural" one, because many

years of experience in making it shows that it is about the least radius at which a tool will maintain a stable cutting point. Even in the United States I have found the same to be true from investigations on the radii of the roots of U. S. S. form of bolts cut by dies, which were nominally, of course, supposed to have a flat root. By using the "projection apparatus," which throws a correct image of the thread, enlarged fifty times, onto a screen, it is easy to measure the radius in question. It was found that the maximum radius of the roots was (where L = lead) 0.13 L, the minimum 0.10 L, and the average 0.12 L. These figures compare very well with the Whitworth minimum stable radius of 0.137 L, for probably the dies were not sufficiently worn to reach the stable form at the crests, and in fact the firm that made the bolts (one of the largest and most reputable in the United States) especially claims that it does not allow its tools to be used when much worn. Of course the crests of the threads of the dies were all of the theoretical flat type when the dies were new, but these soon assumed the rounded shape. The flat top is about the worst for a tool that can be imagined. Apart from the corners rapidly disappearing by abrasion they become overheated and brittle and fall off, a result aided by the difficulty the lubricant has in entering the roots of the product during cutting. Thus the rounded top and bottom for a thread is a practical necessity, and the U. S. S. flat top and bottom is impracticable and consequently hardly ever obtained in ordinary commercial work with taps and dies.

This being the case, in drawing up the diagrams annexed I have given the "natural" Whitworth rounding at the crests and roots of the threads of the several angles, since that is undoubtedly the shape they will have as made, whether we set out to make the flat U. S. S. form or the rounded root of sharp radius striven for in the international type.

The Whitworth radius is used as the minimum radius in the diagrams, and the larger radius required for tolerance in the diameter of the screw is taken as that which bears on the slopes tangentially. A screw was chosen of 1 in. diameter and $\frac{1}{10}$ in pitch, with the tolerances laid down in the new table of tolerances for the British standard fine screw threads of 0.0095 in. at the outside diameter and 0.0126 in. at the root diameter. The diagrams show this screw enlarged several times.

Table II gives full particulars of the qualities of each thread. These may be summarized, taking for the sake of comparison the several proportions of the 60-deg. screw as 100 in each case, the thread being on the "high" limit in each instance.



COMPARISON OF SCREW THREADS OF VARIOUS ANGLES

These figures are very illuminative. We see, for instance, that on the vital requirements of length of engagement on the flanks and depth available at the root for tolerance the smaller the angle the better these are; and so in these main essentials the 55-deg., or Whitworth, form is better than the 60 deg. to the extent of 6 per cent. and 17 per cent. respectively. Much better than

TABLE II. INFLUENCE OF THREAD ANGLE ON ROOT TOLERANCE, LENGTH OF FLANK ENGAGEMENT AND PITCH DIAMETER CORRECTION DUE TO ERROR IN PITCH

Angle of Thread	Length of Engagement On Low "Limits" L_2 proportion	Length of Engagement On High "Limits" L_2 proportion	Depth of Area Available at Root for Tolerance From High Limit proportion	Observation
60° (U. S. S. & International)	56.2%—1.00	52.4%—1.00	13.7%—1.00	The larger the angle the less the depth of engagement and space available at root for tolerance. Therefore the British Association is the most advantageous, then the Whitworth and last the U. S. S. and International. The 45° angle is given for comparison. On the other hand, the correction to the pitch diameter rendered necessary by inaccuracy of pitch bears the following relation to the angle of the thread. If E = error in pitch, then the reduction necessary to the pitch diam. = proportion.
55° (Whitworth)	58.8%—1.04	55.5%—1.06	16.1%—1.17	
47½° (British Association)	65.3%—1.16	61.7%—1.18	20.4%—1.49	
45°	66.4%—1.18	63.4%—1.21	22.1%—1.61	

Angle of Thread	Depth of Thread on High Limit	Proportion
60°	62.4%	1.00
55°	65.9%	1.05
47½°	75.1%	1.20
45°	78.5%	1.25

(1) All the percentage proportions are in terms of the pitch (lead).

(2) The minimum radius of rounding is taken as that for the Whitworth form, and equals 0.1373 × pitch; this rounding being shown by practice to be the sharpest at which a tool will maintain its shape.

(3) The high and low limits are those laid down in the table of new British Standard Fine Tolerances for a 1-in. bolt.

60° thread = 1.73E—1.00
55° thread = 1.92E—1.10
47½° thread = 2.27E—1.31
45° thread = 2.41E—1.43

either would be a 45-deg. thread (which in passing it may be noted is also easily laid out in the drawing office and workshop and has simple geometrical and trigonometrical functions), which is 21 per cent. better than the 60-deg. thread in length of engagement and 61 per cent. in depth available at the root for tolerance.

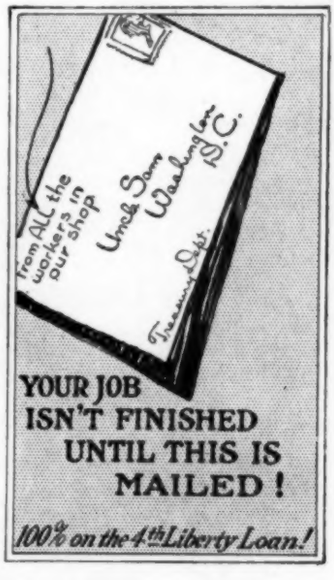
On the other hand there is another important factor to be taken into consideration, and to which only lately has attention been directed (in connection with screw gages chiefly), i.e., the correction necessary to the pitch diameter for any error of lead in the screw. This very important point must be given a prominent place in fixing on a desirable thread angle. The correction in question is 10 per cent. greater for the Whitworth, 31 per cent. greater for the British Association and 43 per cent. greater for the 45-deg. angle than the correction necessary for a 60-deg. thread. The increase for the Whitworth is not of relative importance, but for the British Association and 45-deg. angles it is of great consideration, and would almost seem to put the latter angle out of court, although the other functions of this thread are so desirable.

I think, therefore, that the Whitworth thread, with its "natural" rounding at the crest and root, compared with the artificial and practically never-attained flat root and crest of the U. S. S. form, its great length of engagement on the flanks, much greater space at the root available for tolerance compared with the latter, fully justifies its existence, and in consideration of a standard international thread its many merits deserve careful and studied attention.

Efficiency Hints for Shop Workers

BY GEORGE F. CARD

About a year ago I had the pleasure of assisting in the organization of an employees' research club, which has proved to be very successful. This club is rather unique in three ways. First, the membership is about equally composed of men and women, as also of officers and active workers. The women members take as much interest in the discussion of efficiency problems as do the men, and through their joint efforts many changes in the way of short cuts, better sanitary conditions and a liking for scientific investigation and coöperation have been brought into the shops, and they work more quickly and obtain better results than would be possible in any other way. The second unique feature is that the club excludes from membership anybody of higher rank than the foremen of the shops and clerks in the office. This was not done because of any antagonism between them and the office or from a desire to cook up schemes of unfairness in the performance of their work, but to encourage the younger employees and those who were not very well educated to become members of the club, take some active part in it, and so acquire a habit of study and a broader horizon.


From ALL the workers in our shop
Uncle Sam Washington D.C.
YOUR JOB ISN'T FINISHED UNTIL THIS IS MAILED!
100% on the 4th Liberty Loan!

It was felt that this could be done more successfully if the membership were confined to actual shop and office workers and as much of the shop and office atmosphere brought into the clubroom as possible, so everybody could talk, ask questions and in an orderly way knock things generally without fear or embarrassment. Results have fully justified this course, and the officials are always glad to attend when invited to do so.

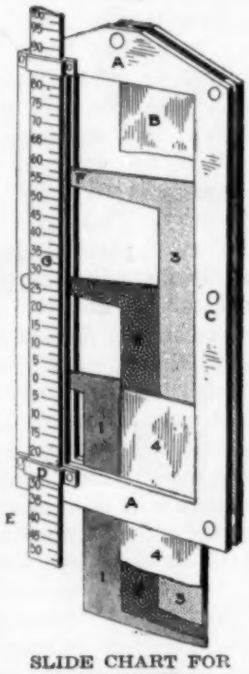
The third unique thing about this organization is the mixed membership; that is to say, employees from as many different industries as possible are admitted, and if from competing concerns so much the better. They hold that shop secretiveness is obsolete and has no place in modern, up-to-date management; that the exchange of ideas is a good stunt to encourage, and a benefit not only to the members individually but the companies they represent, and that a dozen or more ideas of how to do a thing is manifestly more valuable for everybody than a single idea; hence it becomes their privilege and duty to go out and corral as many as possible. If anybody questions this proposition, they are prepared to back it with numerous citations, their own experience and all the logic of scientific reasoning, albeit the language used may expose numerous grammatical ruptures.

I was a guest at one of the meetings of the club recently when the subject under consideration was time and motion studies. For reasons which will appear presently the discussion drifted to graphic representation, charts, diagrams, models and other means for visualizing the things talked about. Two of the members were skillful with pencil and crayon, and the walls of the clubroom were covered with a variety of large and nicely colored charts and diagrams which gave the room a sort of shop atmosphere. Frequent references to these charts removed the proceedings many degrees from the dry-as-dust talks and figures that only a few can understand and participate in to a plane of practical, everyday procedure where even the floor sweeper, who in this case was a good observer and prone to ask questions that went to the bottom of things, could travel along with the rest and understand. What they were confronted with was how to show, in a graphical way, the results of their work in percentages of loss or gain without having to make a chart which took time. The best they had been able to do was to use a small blackboard about two feet by four, provided with horizontal percentage lines, on which could be drawn vertical parallel columns to represent performance or values, and by shading these columns with different-colored chalk crayons a very impressive picture could be drawn in short order. The scheme was a good one, but had the disadvantage that a chart to be reproduced had to be drawn all over again. What they wanted was some quicker way to do this work, and the plans proposed were ingenious and interesting.

One apprentice boy suggested a board with holes in

it where plugs could be inserted and colored twine or ribbons stretched from one pin to another. Another boy improved on this plan by suggesting that colored rubber bands could be stretched over the pins quicker than twine or ribbons could be fastened to them, and scored a point. The most impressive thing about the whole affair, it seemed to me, was the quickness with which an impractical plan was condemned, and one that showed merit approved, demonstrating how the consideration of so simple a thing as chart construction could be made interesting, instructive and of real practical value.

It happened that some time previous to this I had been confronted with the same trouble, and had contrived what I call a slide chart to picture before clubs and skeptical employees the value of correct rate setting. This chart I explained to the club, and they immediately adopted it, and now I understand they have several for use as occasion requires.



SLIDE CHART FOR RATE SETTING

It may be that club members reading the *American Machinist* or ambitious employees studying efficiency methods might like to know more about this chart, and how to construct one. It is a very simple thing to make, and any apprentice boy can put one together in short order. All the material needed is a piece of cardboard (any old pasteboard box will answer), a few paper fasteners and a box of school crayons. Referring to the drawing, first cut out the front piece *A* with the rectangular hole *B* in it; then the back, which should be the same length as the front, but slightly wider so a channel or groove can be bent lengthwise through it for the slides 1, 2, 3 and 4 to move up and down in. Fasten the front and back together with paper fasteners *C;* next cut out the slides 1, 2 and 3, as shown in the drawing. These slides, measuring from the pointer *F* to the back edge, are all a little wider than the opening *B*, but are cut back below the pointer so a portion of the surface of each will be exposed, as shown The scale *G* is then prepared and held in place by cardboard guides *D*. Slide 4 is a plain, white rectangular strip wide enough to cover the exposed surfaces of slides 2 and 3.

The dimensions of this chart can of course be anything wanted, but one of good size is better for club use than a small one. If the exposed surfaces of the slides are 2 in. wide they can readily be seen from a distance. The slides 1, 2 and 3 are colored with crayons of any distinctive color, say red for 1, yellow for 2, and blue or green for 3. This coloring should not extend higher up than the pointer line or farther out toward the scale than the edge of the slide.

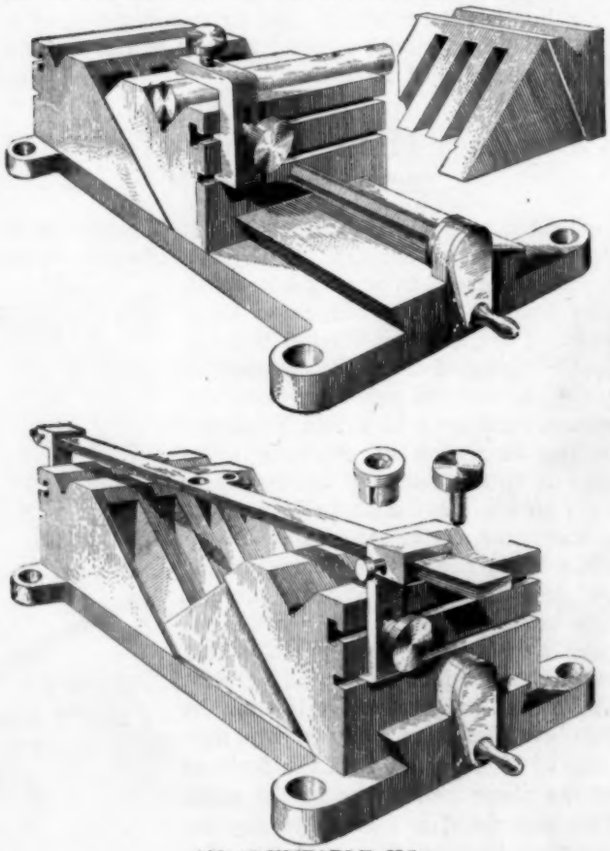
Now to use the contraption. As an illustration I will take one of the examples of rate setting discussed at this meeting. It was a job of machine work changed from day rate to straight piece rate. The result was found to be a 20 per cent. reduction of unit cost, a 25 per cent. increase of earnings by the operator, and a 55 per cent. increase of production. To show this on the chart the scale is first set with zero 20 points above the bottom of the opening in the front; slide 1 is then brought down until the pointer line *F* coincides with zero; then slide 2 is set at 25 above zero, and slide 3, at 55 above zero. Finally slide 4 is brought down to cover the face of slides 2 and 3 below the zero line, which exposes to view only the colored portions representing values. We now have represented on the chart by colored columns a 20 per cent. reduction of cost, a 25 per cent. increase of pay, and a 55 per cent. increase of production.

An Adjustable Jig for Drilling Round Pieces

By J. A. Lucas

A handy tool for service around a sensitive drilling machine is here shown in the sketch. Small Vs are located on both the fixed and the movable jaws, and T-slots are provided at each end for bolting in position any small work that may require holding in an upright position.

Brackets are provided to clamp in any position in the slots, and carry the flat adjustable bar which is designed to hold drill bushings of various inside diameters as well as a clamping screw to hold any work that may be placed in the adjustable V formed by the conjunction of the interlocking jaws. The bar is graduated for convenience in bringing the drill bushing to center in whatever position the jaw may be.


AN ADJUSTABLE JIG

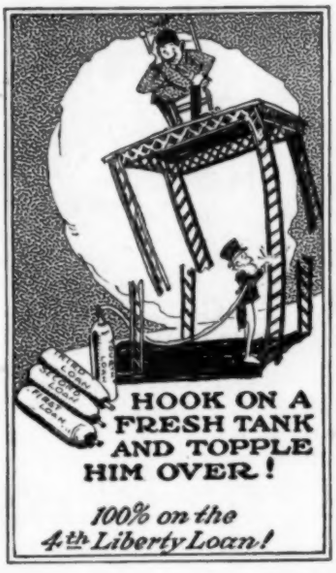
Lubrication of Air Compressors

By W. H. CALLAN
General Manager of Plants, Chicago Pneumatic Tool Co.

The author of this article shows that most of the oil experts figure on heat conditions of the walls of an air compressor which do not exist. The consequence is they recommend the wrong kind of oil.

THE lubrication of the compressor, steam cylinder, main bearings, crankpin, crosshead pin, crosshead guide, etc., does not differ from that of the ordinary steam engine, which is very well known and understood; hence the discussion in this article will be confined to air-cylinder lubrication only.

Years ago when we were young in the compressor business considerable trouble was experienced in procuring a suitable oil for lubricating the air cylinders of our compressors. After considering the matter for some time it was decided that an expert on the subject should be consulted. The matter was taken up with a well-known oil company whose representative called upon us, and after making careful examination of the conditions he reported that our trouble was entirely due to using an oil too light in body and too low in viscosity to withstand the high heat of the compression. He stated that the oil we were using was gasified, due to the high temperature of the air, and that it passed off in vapor, leaving the cylinder wall without lubrication, and recommended a suitable oil. The grade was of 26 Baumé gravity with a flash point of 515 deg. F., fire test of 555 deg. F., and viscosity of 130 S. at 212 deg. F. After having used this oil for some time we found no improvement in the operation of the machine; in fact it appeared to be laboring and the temperature of the discharge air was very high. The cylinder heads were then removed, the valves taken out and a careful examination made. The cylinder wall seemed to have a sticky, plastic coating; the air passages and discharge cavity of the cylinder showed signs of dark deposits, while the faces of the valve seats were covered with a black, hard coating. This hard formation caused the valves to leak, hence the increased temperature of the discharge air, and the sticky coating was responsible for the increased friction. The representative's attention was called to this condition, and he suggested that a little lighter oil be used, this time of 27½ Baumé gravity, flash point 450 deg. F., burning point 500 deg. F., and viscosity about 125 S. at 212 deg. F. On being asked if he did not think this was too heavy for air-cylinder lubrication he assured us it was not and stated that in order to withstand the high temperature of the compressed air it was necessary to have a rather low-gravity and high-viscosity oil with a flash point above the temperature of the air.



After using this oil for some weeks another examination was made, and while the cylinder wall appeared considerably better the valve passages and discharge cavities of the cylinder were badly coated with a hard deposit. The trouble was again brought to the attention of the expert and he suggested that we reduce the amount fed into the cylinder. This was done with great care until we were only using three drops a minute in a 14 x 14-in. cylinder running at 150 r.p.m., but even under this condition deposits in the valve passages and the discharge cavities of the cylinder continued to form as long as we used this oil.

Several months after the expert's attention was again called to the condition experienced with his oil. In regard to the amount we were feeding into this cylinder he said this was reduced to a point that he thought was the minimum. His reason for the formation in the passages was that the residuum of all oils is carbon, and that it was no doubt due to carbon deposits. He assured us that the oil he had recommended was the best procurable for the purpose, and that we should continue to use it without fear of trouble, which we did. However, the formation in the discharge passages seemed to be building up rapidly despite the fact that we were feeding but a small quantity of oil into the cylinder. The formation had collected to such an extent that it was necessary to clean the passages in order to avoid an explosion. Some of the removed material was analyzed and found to contain about 1.5 per cent. free oil, 11 per cent. rust, 5 per cent. decomposed oil, 30 per cent. mineral ash, 10 per cent. coal dust and the remainder foreign matter, or residuum. A further investigation showed that our intake was exposed to coal dust, mineral ash, shavings, water, etc., as well as some air.

After cleaning the compressor and safeguarding the intake against dirt and dust, we procured another grade of oil which we believed was more suitable for the work, as we had investigated and studied the question in the meantime. This oil was of 31 Baumé gravity, flash point 375 deg. F., burning point 420 deg. F. and viscosity 200 S. at 100 deg. F. We started by feeding three drops a minute. Finding the cylinder copiously oiled the feed was reduced to two drops. The compressor was operated in this condition for a long time with practically no trouble from carbon deposits.

Experiencing such good results from this light oil and by this time disbelieving the virtues claimed for low gravity, high flash point and heavy viscosity, we were prompted to try another grade of oil and selected one having a gravity of 33 Baumé, flash point of 380 deg. F., fire test of 420 deg. F., and viscosity of 140 S. at 100 deg. F. The same quantity was used as before,

namely, two drops a minute in a 14 x 14 cylinder running at 150 r.p.m. This oil was used for years without any trouble in respect to lubrication, valve leakage and carbon deposits—in fact it proved to be very satisfactory in every way.

The oil representative made his regular calls on us and each time we told him what we were doing. He assured us we were on the wrong track and that sooner or later would get into trouble, but after continued tests and very careful observation of all conditions, we are satisfied that the latter oil is the most suitable for air-cylinder lubrication when working against 100 lb. pressure, either single or two stage.

One day an old friend called, who was also an expert for an oil company. On being told our experience with air-cylinder lubrication he too assured us that we were using the wrong oil and said, "You know you get not less than 400 deg. F. in your air cylinder when working against 100-lb. single stage." With this I agreed. I then asked him how he knew we were wrong, and what means he employed for ascertaining the proper grade of oil for air-cylinder lubrication. He then explained to us the method his company's engineers use in determining the proper oil for different kinds of service. He said:

"Since you have agreed that the temperature of the air is 400 deg., our test would be conducted as follows: Take a block of cast iron 6 in. or 8 in. square and 2 in. thick; place this block in a layer of sand in a shallow iron pan, pack the sand closely around the cast-iron block, then put a gas burner under the pan and turn on the heat slowly. The top surface of this block is polished and has a drilled hole, and into the hole a thermometer is inserted. Heavy steam-cylinder oil is poured into the hole around the thermometer bulb so as to make a close heat contact. When the thermometer rises to 400 deg. lower your gas burner until the thermometer remains at 400 deg. Then take your different samples, dip the point of a lead pencil into the oil, hold the pencil 2 in. from the surface of this iron block and allow a drop to fall on the hot polished surface.

A Higher Grade of Oil

"When such a test is made with the grade of oil from which you say you are getting successful results it is found the drop spreads out to about 1¼ in. in diameter, smokes a little, dries up, and is evaporated in 10 sec. time, leaving the surface perfectly dry. With a higher grade of oil having a flash point of 450 deg. F. and heavy viscosity, when the drop falls on the surface of this polished block it spreads out to about 1¼ in. in diameter, smokes a little, but, after 5 min. the surface is still oily. Thus we have proof that this is the proper oil to withstand such service as you get in your air-compressor cylinder."

I asked him what he thought the temperature of the surface of the cylinder wall was when the air in the cylinder is 400 deg. F. He hesitated, then said he believed it would be about 25 deg. F. less than the temperature of the air. I disagreed, saying this did not seem right, as the water-jacketed wall should be much cooler than the air. We went into the office and consulted some authorities. We found some tests had been made abroad on the temperature of the cylinder walls in an internal-combustion engine where, with an explosion temperature of 2700 deg. F. and an average temperature through the cycle of 950 deg. F. and the water in the jacket at 200 deg. F., the inside surface of the cylinder wall did not go above 267 deg. F. When shown these figures my friend was nearly speechless and admitted that he had never thought that the temperature of the wall of an internal-combustion engine cylinder with an explosion temperature so high could remain so cool. However, as the character of the authority was such that it could not be questioned it was accepted by the oil expert. I then asked what he thought the temperature of the air-cylinder wall should be when the air does not exceed 400 deg. F. He said he did not know, but did not believe it would be very much above the temperature of the water in the jacket.

As a matter of fact, the temperature of the inside of the cylinder wall of a water-jacketed cylinder is not more than 30 deg. F. higher than the temperature of the jacket water, as long as the water does not boil; and since this is so, what is the use of using oils of low gravity, high fire test and high viscosity to meet a condition such as this one now appears to be? The temperature of the inside surface of the cylinder wall on an air compressor is very little, if any, above the temperature of the surface in the main bearing of the ordinary Corliss engine.

From this it appears that the expert who lays stress on high viscosity and flash point has not considered the true conditions. We have shown that the cause of carbon deposits in the passages of an air cylinder is not always entirely chargeable to the residuum of oil, but in many instances is due to using an oil of too heavy body, which adheres to the passages of the cylinder, and furthermore, when the inlet is not properly protected from foreign matter, material such as coal dust, mineral ash, shavings, waste, etc., is drawn into the cylinder and deposited on the sticky surfaces coated with this heavy oil. This foreign matter, with the additional oil, gradually builds up until the passages become choked, and the air valves begin to leak for some reason, thus increasing the temperature, until finally it sometimes reaches a point as high as 500 deg. F. when compressing to 100 lb. single stage. If there are many shavings or very much coal dust deposited in the passages, it is apt to char and become incandescent. When it does, the temperature of the air rises very rapidly and, as a consequence, the pressure increases quickly to a point beyond the strength of the receiver and results in what is generally called an explosion.

In my opinion no violent explosion ever takes place in an ordinary air compressor unless kerosene, gasoline or some such material is introduced.

I had an experience some years ago with a two-stage compressor where the intake had been neglected and also the wrong grade and quantity of oil had been used; the high-pressure discharge valves became leaky, allowing the air to churn in and out of the cylinder at each stroke and heating it until it became so hot that the heavy deposits in the passages actually took fire. The whole system burned out like a chimney of an old-time wood stove. Fortunately there was no explosion because the safety valve on the receiver relieved the sudden pressure caused by the burning material in the discharge passages and the compressor was promptly shut down.

From the foregoing it will be understood that in the selection of an oil for air-cylinder lubrication nothing should be used but a pure mineral product having a gravity of from 31 to 33 Baumé, a flash point of 375 to 390 deg. F. and a viscosity of 140 to 150 S. at 100 deg. F. Under no circumstances should a heavy grade be used despite any claims made by the oil salesmen of the virtues of heavy viscosities or high flash points. It should also be borne in mind that when the surface of the cylinder wall is once glazed over, very little oil is required to properly and adequately lubricate the working surfaces.

The film of oil on the cylinder wall is understood to be less than 0.00025 in. in thickness, and since in the operation of compressing air there is practically no moisture the piston rides back and forth on this film and requires very little oil to be added in order to maintain the quantity required. Should a greater amount of oil be used than just enough to keep up the required film it will be plowed up ahead of the piston and be forced through the valves and into the cylinder cavities, where it will collect in the low places and solidify by reason of being mixed with foreign matter taken in through the inlet.

As has been shown, a 14 x 14-in. cylinder can be adequately lubricated with two drops of oil a minute when the compressor is operated at 150 r.p.m., being the equivalent of one drop of oil for each 600 sq.ft. of cylinder surface swept by the piston. The oil here referred to was of paraffine base. However, I believe that an oil of about the same consistency, refined from an ashphalt base, would serve as well if not better.

The Passing of the Machine Trade

By Harry Senior

On page 426 of the *American Machinist* Entropy bewails the changing conditions that seem to be crowding the old-time machinist out of the bustle and turmoil of contemporary things and into the pages of history. He tells us about our grandfathers' time when a man was supposed to be a complete craftsman (jack of all trades, I think we called him) and capable of building a house from laying the cellar wall to papering the "boodwoir."

Now I am not anybody's grandfather, but I am old enough to be on terms of comradeship with the grandchildren of some of my old schoolmates, and as I remember the houses of the remoter period which were hand made from cellar to rooftree it seems to me that almost anybody of average intelligence could duplicate the feat at the present time if he wanted to.

I cannot see that the skill and intelligence of the old-time craftsman is in danger of being lost to the present generation in the maze of present-day machinery; rather is that maze a sure indication that we have the old-timer with us in the person of his son or his grandson.

Beginning with 1914 there has been an enormous expansion in the machine industry (this is not intended as the betrayal of a secret) and a thousand machinists are required where but one grew before. Now 1914 is barely four years in the offing, but there was a time when we thought it took seven years to make a machinist. Nowadays there are schools that claim to do it in from three to six months—or is it weeks—but is it not possible that they are mistaken, as our forefathers must have been about the seven-year period?

Personally I do not believe that the skill, delicacy of touch, judgment and sense of fitness of things mechanical can be acquired in a school any more than the courage, judgment and resourcefulness of an experienced locomotive engineer can be instilled into him by sitting him in front of a screen upon which moving pictures taken from a cab window are projected.

School for Fundamentals

I believe that schools for teaching the fundamental principles of the machine trade to the younger generation should be provided to the necessary extent, exactly as a primary school is provided to teach the child his A B Cs before he goes into the higher grades. But such training must be regarded as merely elementary; the graduate of such a school is a neophyte, not a machinist, and before he attains to this high estate he must go into a shop where actual work is done and results other than merely educational are looked for.

The reason for the partial failure of our prevocational and trade schools is that too much was expected of their graduates. It may be said that there are schools organized on the basis of a shop, where real work is done and where the school is supported by its product; but unless the student is paid for his time and made to realize that his continuance is contingent upon his making good, the requisite conditions are not fulfilled, while if all these things are provided for, the school has become a shop and there is no necessity for worrying about who is going to pay the bills.

The reason for the apparent passing of the old order is principally that when we are talking of machinists we are thinking of machine operators. There is no more reason for calling a boring-mill operator a machinist than for calling a foremast hand a navigator. Either may be considered an apprentice, a potential craftsman who, plus education, both technical and practical, will some day advance to the better position, and in the case of the machine operator at least (I never went to sea much) the opportunities of acquiring that education are greater now than they ever were before.

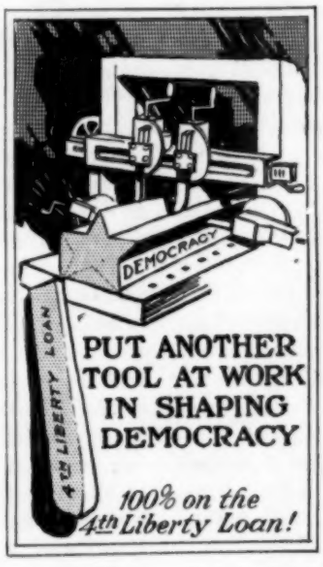
The machinist of yesterday is the toolmaker of today. He may be the foreman or the superintendent next week, and he will see to it that there are young men, or perhaps young women, trained to take his place—not enough for present needs perhaps but enough so that when world equilibrium is reëstablished the old-time machinist will be found on the job under a new name, looking younger, healthier and very likely more attractive than of yore and not one whit less capable and efficient.

Abnormal Movement of Machinery

By CHESLA C. SHERLOCK

Many accidents in factories and machine shops arise from unusual conditions entirely beyond the fault of either the employer or the employee. Many times they are due to sudden or abnormal movement of machinery, such as to take the employee by surprise and cause the injury for which suit is brought.

IT WOULD seem on first thought that any abnormal movement of machinery would be prima-facie evidence of negligence or faulty construction such as to render the employer liable for the injuries sustained. The mere fact that a machine suddenly changed its position or turned around in such a way as to injure a workman would look as if the employer had not performed his legal duty to provide his workmen with "a reasonably safe place to work." Employers are permitted to and often overcome such prima-facie evidence by proving that the machine was in good condition and worked properly before and after the accident. It then falls upon the complainant to explain satisfactorily the cause of the abnormal action of the machine by showing that it was not in a proper state of repair or was not reasonably safe.



Where it is claimed that a machine made an unprecedented movement the Wisconsin court has said that it is the duty of the employee "to show not only that such movement was made, but also the construction of the machine, so as to establish that such movement was caused by defective construction or want of repair, and was probable, so that such result might in the exercise of ordinary care have been anticipated by defendant, this anticipation of injury to someone being an essential element to actionable negligence." But the Massachusetts court fixes liability by saying that the unexplained automatic starting of a machine when according to the laws of its construction it ought to remain still is not only evidence of a defect or want of repair, but also of negligence of the owner or person in charge of it in failing to discover and remedy such defect or want of repair.

In speaking of the Massachusetts rule the Indiana court said: "Our courts have not yet made any pronouncements in conformity with the holdings in these cases, but there is no conflict between the doctrine there announced and our holding. The master, in a case like this, must have had actual or constructive knowledge of the defect in time to have repaired it or warned the servant before he can be held negligent. When the Massachusetts court held that negligence might be inferred from the mere unexplained starting of a machine, it in effect held that knowledge of the defect for a period of time sufficient to repair or warn might be inferred from such evidence. In this case the jury has specifically found that there was no evidence as to how long the defect has existed or how long the master knew of it."

It might be explained that the only theory upon which a workman could bring a suit for damages against his employer for the unexpected movement of machinery is that the employer was guilty of negligence in maintaining a machine in his factory in such defective condition. Negligence is that which has been used in courts of law for a long time, and its meaning is subject to nice shades of distinction. What might be termed negligence in one case would not amount to it in another. It is well to note that before an employer can be held guilty of an actionable negligence for the unexpected movement of machinery it must be proved that he had previous notice or knowledge of the existence of a defect or want of repair in the machine.

It will be observed that the Massachusetts court imputed negligence to the employer from the mere fact that the machinery made a sudden movement by presupposing that it was in defective condition. This led the court to believe that if it was in faulty condition someone must know about it, and that if no one knew about it the man in charge was guilty of negligence for not paying more attention to the workings of his machine. This may be a good rule to adopt, and there seems to be little dissension from it, although the Indiana court has drawn a sharp line between its holding and that of the Massachusetts court.

Imputed negligence is where somebody else is guilty of the negligence of another, to put it in a loose and homely way. The negligence of a foreman, for instance, is often imputed to the employer; that is, the employer is liable for the negligence of his subheads or representatives. Imputed negligence is a necessary device in promoting justice at times, but it is also very dangerous if carried to extremes by placing the liability where it should not rest.

In all fairness it should be stated, however, that only the unexplained automatic action of machinery when it should remain at rest will give rise to the Massachusetts rule mentioned above.

An Indiana case shows how much the burden of proof rests upon the complaining employee in such cases. The plaintiff was an operator of an automatic punch press in the defendant's factory. It was claimed that the plaintiff was injured while working upon the press, which was operated by electric power; that the press had become out of order so that at times it could not be started in the usual manner by applying the pedal; that defendant instructed the plaintiff to use an iron rod to raise the crankshaft to center, and when so raised to start the machine with the pedal; that

the press failing to start by the use of the pedal she attempted to follow the instructions given to her and while so doing the press suddenly started and threw the rod against her hand and fractured her wrist. The plaintiff also claimed that the defendant had knowledge of the defective condition of the press which condition was unknown to the plaintiff.

The court held that the burden being upon the plaintiff to show not only that the defendant knew of the defects which caused her injury, but that he had such knowledge, or in the exercise of due care could have had such knowledge long enough before the accident to have repaired the defect or to have warned the plaintiff, a finding of the jury, in answer to interrogations, that the machine was out of order in such a way as to cause the accident to the plaintiff, that there was no evidence as to how long it had been out of order, that defendant's foreman knew it was out of order but that there was no evidence as to how long he knew of it before plaintiff's accident, was a finding against the plaintiff upon one of the vital elements of her cause upon which she had the burden of proof.

This decision drives home the necessity of employers having knowledge of a defect in a machine of sufficient duration to permit them to repair the defect before they can be held to be guilty of actionable negligence. It should also show that unless there is knowledge or notice of a length of time sufficient to permit of such repair that negligence cannot be imputed to the employer except the circumstances are such as were present in the Massachusetts case.

In another case the plaintiff, a boy 14 years of age, was working on a can-making machine. "The machine was operated by power. At its front were two projections, or 'horns,' one stationary and the other movable. At the bottom of the machine was a treadle worked by foot. A can would be placed over the lower projection; then by putting the foot on the treadle the upper projection would come down on the can, clamping its seam. The upper projection would then go up and if the foot was taken from the treadle, the upper projection would remain at rest and not come down again."

The Opinion of the Court

It was shown that the plaintiff took his foot off the treadle and that he then heard something snap and the upper projection came down and mashed his thumb. In reaching an opinion the court said: "There is no dispute that from the fact of this unexplained starting at a time and under circumstances when it ought not to have started at all the jury could have found that there was a defect of some kind in the machine and that this defect was the cause of the undue starting or 'repeating' to which the injury was due. But the defendants contended that this, standing by itself, would not have warranted the further inference of any negligence or failure of duty on their part."

The court then quoted the Massachusetts cases and explained that they had been quoted favorably a number of times and suggested that they should have been submitted to the jury, and so remanded the case to the lower court. This was, in effect, a reversal of the verdict handed down by that court for the employer.

In Kansas the plaintiff was injured by a conveyor belt which suddenly started while he was working in an elevator box in the defendant's plant. "The power running the conveyor belt came from a horizontal shaft on the fourth floor of a building which was so arranged that when the belt worked upon a pulley which revolved with a shaft the power was transmitted, and to throw the power out of gear it was necessary for a workman on the first floor to pull a rope reaching down from the fourth floor, which changed the belt over to a loose pulley not revolving with the shaft, and to put the belt in gear there was another rope by which the belt could be drawn back so as to run over the fixed pulley. The petition alleged that the apparatus for starting and stopping the conveyor belt was in a defective condition."

Among other things the petition set out that the conveyor belt would start in motion after having been thrown out of gear "without anyone having pulled the rope provided for that purpose by reason of some defect in the machinery for throwing and keeping said belt out of gear."

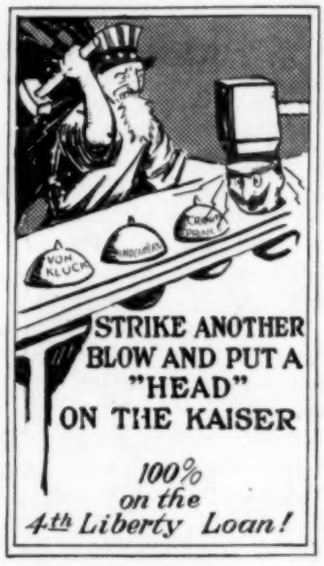
The Plaintiff's Duty

When the conveyor belt became choked it was the plaintiff's duty to throw the belt out of gear and clean out the elevator box. In attempting to do this he pulled the rope in the usual manner and while cleaning the box the belt started up without any warning, pulling his hand up and crushing it. The jury was unable to state, upon special question, what started the belt into motion. Said the court: "While the defendant is not entitled to a judgment on the special findings, the entire conclusions of the jury leave the case in the condition of having found in favor of the plaintiff (employee) while failing to find one of the essential elements of his right to a recovery. It was alleged and found that the defendant had not furnished plaintiff a safe place in which to work, but it is clear that the controlling cause of such unsafety was the tendency of the belt to shift from the loose to the fixed pulley, and in this instance it was necessary to prove that such shifting occurred without human agency."

In another one of these Massachusetts cases, a case which is considered by many authorities as the leading case on the subject, it appeared that the plaintiff was operating a loom in defendant's mill, the machine being stopped and started by a shipper, which moved the belt onto and from a tight and a loose pulley. Three months prior to the accident the plaintiff had had trouble with the machine, which she had reported to the loomfixer, who made repairs thereto. At the time she was injured she had stopped the loom to repair a bad place in the weaving, and while doing this, with no one near, the loom started without any apparent cause, injuring her arm.

The court said: "In most cases of the automatic starting of machines from a state of rest there has been some evidence of a previous similar starting, with notice of which the defendant might have been charged. But it is not necessary, in order to establish negligence of the defendant, that she should have had express notice of the precise irregularity which resulted in the injury. It is enough if such circumstances appear as to render it likely that the harmful event would not have happened except for some act or omission amounting to a want of ordinary precaution. The mere starting of a machine, without the intervention of any human

agency and when it should have remained at rest, is of itself evidence of some defective condition. To this extent the doctrine of *res ipsa loquitur* (the thing speaks for itself) has been established. Here the machine had been used many years, and the shaft had become so worn that it was necessary to substitute a new one, and there was some slight evidence that the adjustment of the new shaft to the old loom was made in such a manner that it might have been foreseen by one familiar with the mechanism that the belt was liable to work from the loose to the tight pulley. These circumstances, in connection with the fact of the starting of the machine, constitute not only evidence of the defective condition of the machine, but also that the defendants, in the exercise of due precaution, might have discovered the defect." In the beginning of this article it was stated that the burden of proof was upon the complaining employee to establish not only a clear case for himself but also a case against his employer. Where the legal doctrine of *res ipsa loquitur* is established and applied, however, the burden of proof falls upon the defending employer and it can readily be seen what a big advantage this is to the suing employee. This doctrine is merely that the thing which happened speaks for itself. No other evidence is necessary on the part of the injured person; he has been so grievously wronged by the act complained of that the court looks to the defending party for explanation. The Pennsylvania court has said that an accident due to the carelessness of a fellow servant, even though it involves a machine or machinery, cannot be said to be due to the abnormal movement of machinery, but that the fault must rest with the careless workman and not with the employer. This decision is valuable only in defining what constitutes an "abnormal movement of machinery," as it would, at the present time, be largely abrogated by the workmen's compensation acts if the employer or employee should happen to be operating under them.



Treating of a similar accident a Kansas court held that while the sudden fall of an elevator cage in the course of its ordinary use warrants an inference of negligence it does not as between employer and employee raise a presumption of culpable negligence on the part of the employer.

A Wisconsin Case

In a Wisconsin case the plaintiff was injured while working on a hydraulic elevator. His legs were caught by the alleged abnormal movement of the elevator. Said the court:

"The negligence alleged was that there was a leak in the intake valve of the elevator, that such defect had existed for such a length of time as to charge defendant with actual or constructive notice thereof, and that defendant failed to warn plaintiff of such defect. . . . There was also testimony to show notice of the defect. The water pressure was 55 lb. to the square inch.

"The employer contended that the evidence as to the jerky motion was contrary to physical laws as, water being practically incompressible, with a constant and steady pressure a leaky valve would produce a constant and steady upward movement of the elevator, and further contended that the evidence did not show that it had any knowledge, actual or presumed, that there was a defect in the valve prior to the time of the plaintiff's injury."

The court found that there was evidence that the valve acted abnormally when opened, but that there was no evidence that it acted abnormally when closed. It further found that the proof failed to show actionable negligence on the part of the defendant and directed a verdict in his favor. On the whole it will be observed that the law is exceedingly favorable to the employer upon this point; favorable because it is extremely difficult for a workman to recover damages unless the doctrine of *res ipsa loquitur* be recognized. The evidence that machinery causing an accident by abnormal movement has acted in the same manner at a time prior to the accident and sufficiently prior to enable the employer to remedy the defect will in the majority of cases make a clear case against the employer. On the question of notice or knowledge we find the parting of ways. Some courts hold that no actual notice or knowledge is required; that it will be presumed from the act itself, or should be inferred from the fact that it was not discovered in time. Other courts will require the strictest proof that actual notice or knowledge was had by the employer. The workmen's compensation acts may affect some of these cases in states where they are in force, provided the employer or employee have expressly accepted those acts and are operating under them. It is well to remember, however, that the compensation acts have nothing to do with the employer's duty to provide the employee with a reasonably safe place to work and to do all that he can to prevent industrial losses.

It is a very different matter taking care of employees before they are injured by guarding machinery and making necessary repairs and taking care of them after the injury has occurred. The compensation acts could affect only the right to bring an action for damages. If the employee is denied that right under the compensation acts, then he would take compensation according to the law, and the question as to how he received his injury would be of small consequence in the final settlement.

But in many states the employee has the right to elect what course he will pursue, and in others he may sue for damages and failing to recover he may resort to compensation, this giving him a rather better chance than where one course only can be followed.

These decisions are of importance to employers and it is well that they be considered without thinking too much about the compensation acts, as the liability is there, even though this may appear to some to be only a novel phase of law.

Testing the Buying Power of a Foreign Market

By L. W. SCHMIDT

The increased capacity of many of our machine-tool shops due to war work is making our managers consider the question of export more carefully than ever. This article contains suggestions as to ways of estimating the probable markets to see whether it will pay to send representatives later. It gives the sources of information and shows how it can be judged and collated for future use.

IN ENTERING a new market the principal question must always be, Will the sales finally be big enough to recompense the firm for all the initial expense and trouble incidental to the opening of a new sales field? This is the case as much in the home market as in foreign markets, only in the latter the stakes are, as a rule, comparatively higher. It is not very difficult to have an experienced man go over a state of the Union to study the situation. His traveling expenses will be slight, and the experience will be valuable for the future development of business in the new territory. But it costs a good deal of money to send a man to Argentina, to Australia or South Africa for only a look around.

On the other hand the work of years, the great cost of a price list, postage and advertising may be wasted if a study is not made of a market. In this respect the machinery industry might be hit just as heavily as any other. In fact, drastic disappointments caused by misjudging a market are more frequent in the machinery field than in any other field of export enterprise, the reason being that the selling cost of machinery is considerably higher per unit sold than most other merchandise.

New Markets for Machine Tools

The maker of machine tools and general machinery in this country, therefore, is advised to look carefully into a new market and not to attempt anything until he has gained a complete knowledge of the conditions of it. The principal questions that must be answered are: What are the present conditions as to machine employment? What competition exists and what can be expected? What is the price of the competing machine, and what prices can be realized for their own? and What is the highest number of machines which may be sold reasonably?

From an answer to all these questions the sales policy of the manufacturer must depend. Conditions in the industry of the market to be supplied may be of such a character as to exclude absolutely the sale of the machines the import of which is contemplated. Existing competition may be so strong as to make it inadvisable to introduce the product, or prices so low as to put it out of competition. Finally, the sales possibilities may be too limited.

Given money and time, these questions can be answered. A confidential representative can visit the market to study it. This, however, is costly. It may appeal to the rich manufacturing concern, but its application would practically exclude the medium and smaller machinery manufacturer from export trade. Cheaper and quicker means, therefore, will have to be devised, and they must be such as can be employed from one's desk.

I have gained much experience in making such investigations during many years of service as export adviser to industrial concerns, and the method which I employed may be of interest to others. The principal question which is asked by the would-be exporter is, as a rule, How much can be sold, and will the results finally justify my outlay? The answer must be as correctly as possible a statement as to the sales that can be expected, and advise as to how much the exporter should spend to gain his object. The preliminary inquiries must be directed at first with a view to solving the four problems mentioned above, namely, local conditions, competition, price and capacity.

Use the Department of Commerce Literature

It may be said that in every instance where I had to make an inquiry of this character I have found the publications of the diplomatic service of the various countries of great assistance, especially the reports issued by the United States Department of Commerce. The next best are the Belgian for certain industries, followed by the Austrian, which excel in their practical arrangement. The English and German consular reports mostly are too dry to be of much value, but the French deserve close studying, especially those dealing with textiles and textile machinery. None in any case, however, have the punch and intimacy of the present United States Department of *Commerce Reports* contained in the so-called Agents' Series. By reading these reports carefully a very good general impression can as a rule be gained of the market and its possibilities and the foundation for further researches at least laid.

Take the case of a machine-tool manufacturer intending to export certain machine tools to Australia. An initial study should be made of the general industrial conditions of that country, interesting information of which can be found in the introduction to each volume of the Agents' Series. This deals with the climatic conditions, population, general industrial development and other points of interest. Following the reading of this general matter the search has to be extended to the more special information. Today machine tools are required in all industrial enterprises. The customers of the machine-tool industry are the construction shops, machine builders, repair shops and other enterprises of similar character, and our Department of Commerce has set out to study these industries individually in other countries. The conditions in the hardware industry of the world, in the iron and in the electrical industry are intimately described in these reports, and only recently a very fine report was published dealing with the sale of railroad material in Australia. These reports give the most minute in-

formation about local conditions in each industry, and their perusal is strongly recommended to those intent on making a study of the sales possibilities for machine tools in any given country.

To read a report about the conditions in the textile industry may not appear of interest to the man who wants to sell a turret lathe, but he should not forget that every machine unit employed in the textile industry means a corresponding machine-tool unit for repair work. Every additional rail laid in New Zealand necessitates an extension of the repair and construction facilities of the New Zealand railroad repair and construction shops. This means more machine tools will be needed.

The principal advantage gained, however, by reading these reports is that the mind of the susceptible reader is slowly impressed with an understanding of the large economic factors which govern the market he wants to sell to. His senses become more acute for all the other factors as he presently will discover while continuing his study. Without realizing it he begins to draw a mental picture of the country. He sees before him the net of railroads connecting the coast towns with the mines; he sees the agricultural machines moving over the wide plains, and the factories at work supplying the many needs of the market. And while he paints this mental picture, there comes to him a desire to make comparisons. The city of Cristchurch in New Zealand becomes a reality. It finds its counterpart in some small or large city in the United States, in Canada or in any other of the markets where the firm has been selling. This picture helps to clear the understanding of the market. New Zealand with its industrial needs is nothing else but a much smaller Middle West, with its growing population and its multifarious industrial requirements. The equipment of its machine shops will not be much different from that in the industrial communities of the Middle West. Its labor problems may be the same, also its industrial development. This picture is later corrected by further reading, and experience is necessary to make it complete, but it is extraordinary how correct an impression one can gain about the general industrial conditions of a market by reading the reports of trained industrial observers.

Many of the reports of the Agents' Series are now illustrated, and this helps a good deal. In fact not enough pictures and photographs can be seen, and if they cannot be found in the books on hand it pays to hunt up illustrated magazines or to write to the market for picture postcards or other material of this description. Much useful information can be gained as a rule by reading the local press. As it will be necessary during the future course of business to be correctly informed about everything important happening in the industries to be served, one of the technical journals should be subscribed for, as it is sure to contain information. It will help especially to inquire also into the question of local and foreign competition.

I confess to gaining my initial information almost exclusively from the trade press. The advertising pages of the technical press are the principal places to look into. If a good representative journal is read it will be found that nearly all the competing firms that amount to anything advertise. This is as true of the local concerns as of the importers. In the case of the latter there is the difficulty of not always being clear as to what firm is represented by the import agent.

The advertising pages, however, are not the only source for this kind of information, the so-called small news columns of the technical press also containing information relative to new installations, extension, etc., in industrial enterprises. One will then read with interest that Messrs. C. & Co. have just installed a new H. B. power cutter, and similar news, which is just the kind of information looked for.

Immediate notice of this kind of information should be taken by putting down the names of these firms on a card for index purposes, and also to note other special points that have appeared earlier in reading. I follow the practice of marking in the books I read everything that appears of interest to me and having it copied, thereby retaining all useful information for future use. In the case of research into the possibilities of a market the name of the market, for instance, would do. Having secured in this way a list of the most important competitors the next step is to inquire into their selling prices. Every traveler knows by way of his customers most of the prices of the competing firms, so there is really very little secrecy to this. To get at the local prices of the machine in question in the market under consideration it is then necessary to add the special exporter's profit and the cost of transportation, which together will allow a fair estimate of the price of the machine. If a number of machines of the same class and character are in the market the price of each should be established, and if great differences appear in the prices it should be found out immediately why this is so. The latter information will be of enormous importance in the course of the selling campaign.

The search for information is completed by an inquiry into the quantities and values of the machine tools that were imported into the market and that are of the character of the machine that one desires to sell. This inquiry has to be extended over a number of years, and should cover not only the actual quantity and value, but also the countries of origin of the imported machines and the quantities and value imported by each country. If great differences appear in the annual imports with reference to the total or the participation of the individual countries of supply the reasons for these changes must be discovered.

I have frequently obtained much useful information by doing this, especially as to the entrance of new

firms into the market and the influence of their appearance on the general course of business.

The import statistics of the market under survey can be checked with advantage by also looking into the corresponding export statistics of the countries of origin. As nearly all countries have a different system of recording it often happens that important hints can be gained by this simple means. Germany, for instance, records in the case of machinery not only the value and the number but also the weight, which allows a fair guess at the character of the exported machines. Similar instances can be found in the statistics of other countries.

It may pay finally to write for a local trade directory in order to see what information can be gained from it. As a rule it will contain a classified list of the leading industrial concerns that may become buyers of the machine one desires to export, and it will also often furnish a list of the principal local and foreign competitors.

Preliminary investigation can be supplemented by reading up the census reports of the market, which as a rule are obtainable in the libraries. This is purely statistical information, some of which, however, is valuable. For instance, there can be found such important hints as the number of factories that employ power and how much, and the number of industrial enterprises, the number of men they employ, their production and expenditures.

Checking Up the Results

After having collected all that is useful the next step is to sort the material and group the items according to their importance. This is best done with a special object in mind. Taking again the case of the machine-tool maker, the question will be asked, What will he have to know about the conditions of the market? He will have to know the number of establishments likely to buy machine tools and their grade of technical development, and this may be found out by recourse to the trade directory and the census reports. Information can also be obtained by studying the general information collected in the beginning. This of course will have to be sorted out first from the material in hand. The single sheets containing the various notes made in the course of the work are read with a view of excerpting all suitable items. These are marked again with a distinctive mark, and it will be of advantage to give at the head of each sheet a gist of the information contained therein. In doing this the reader will quickly clear his mind of all that is superfluous and obtain a correct impression of the general development of the market.

Having settled to his satisfaction the present industrial standing and development of the field of future operation it is not difficult to select the class of machinery which should prove most salable. In many cases it may be realized at this stage of the work that the market does not hold sufficient promise to make it worth while to go deeply into it, and action can be taken either by dropping the job or by regulating any further efforts according to the likelihood of success. Whatever the decision the cost and labor so far expended will have been less than if a special representative had been sent, who returned with the same result but including a good-sized cost bill.

If the results encourage further investigation the inquiry is now extended to the questions of competition and price. The existence of competition in itself is no hindrance; in fact, where competition is found in a market there is the *prima facie* presumption of an active demand. It is then necessary to find how far competition will affect the sales of the newcomer. This is a question as much of personality as of quality. The person of the agent or representative must be considered here together with the machine. If the new machine is cheaper than the competing machines it most likely will gain customers on the strength of this fact.

If a good agent can be put forward he may be able to overcome even the difficulty of a higher price, but one should not rely too much on either. The extent of the prevailing competition will influence a good deal the estimate of the likely cost of introduction. If the competing firms are big advertisers it will be necessary to do the same. If they are advertising only on a small scale this item of cost also may be kept smaller, unless it is desired to lay special stress on a campaign of general education which, however, also must depend on the conditions in the market.

The Size of the Market

The most important factor to know, of course, is the capacity of the market and its likelihood of further expansion. Taking everything into consideration it would seem that the chances for a newcomer are better in a market that is still not supplied to capacity or has chances of growth than in one that has already become stationary. To make an exact estimate with reference to these two points is very difficult, and even old hands at this kind of work will fail at it at times. It is therefore best not to be too optimistic, but to proceed in the following way:

See how many factories show a certain minimum of productive capacity and employ a certain number of hands. The chances are that more intimate information of the machine equipment of a similar factory can be had, which then can be used as a basis for a special estimate. If no such information is available a similar factory in another known market of the same grade of development can be used, and, this failing, the conditions of our United States industry must be employed to make the estimate. It should now be established how many machines of the sort to be sold abroad are used per man or per hundred men in the factory in question. Assuming that the figure obtained is three per 100 men it may be taken as fairly certain that at least that number multiplied by each hundred-unit of men employed in the industry should be salable. Furthermore, each of the smaller factories growing slowly into the 100-men class also will become automatically a new customer, adding a demand of three new machines to the existing sales possibilities. Assuming now that the estimate shows a possible sale of at least 300 machines a year, and that with depreciation and new demand an additional sale of 40 machines may be considered likely, what will be the portion of the newcomer under these circumstances?

The first question to answer is, Have all the 300 likely users already been supplied? The import statistics from over a number of years may give an answer, even if incomplete, to that question. A fairly correct estimate can be made when the actual number of imported machines is obtainable, hence the advantage of also inquiring into the export statistics of the supplying country which may contain just that sort of information. If it is not obtainable some sort of an estimate based on value must be made. This can only be very general in its results. It is, however, astonishing how near even such general estimates very often come to the facts and how profitable the results can be made. Men who do this work often doubtless gain much experience, a sort of an instinctive ability which will guide them in their work and produce correct results even in the most difficult cases.

The newcomer most likely will set out to get at first the business of all those who so far have not bought their equipment from either of the existing purveyors. His second step will be to gain part of the trade accruing newly every year in the form of replacement orders or new firms entering the circle of likely customers. The market to go for will be, therefore, that not provided for by the existing competition in the market or by direct supply from abroad and a percentage of the running business that should expand with every year according to the ordinary growth of the market.

The result of this estimate should form the basis for the further decisions of the factory; it will govern the policy to be followed in the market into the conditions of which an inquiry was made. The great value of such preliminary inquiries will only be realized after several of them have been completed. They will prevent the expenditure of money and energy in unprofitable fields, and they will be a useful preparation for any sales campaign in markets where conditions prove favorable to the machines manufactured by the exporting concern. This is especially necessary just now when every bit of energy must be employed as usefully as possible, and it also will be of vital importance after the war. To know exactly where to begin in the vast field of international commerce means the battle half won. The machine-tool industry will have much competition—more cause that it should make early arrangements for the future and select the most promising markets.

It may be said that inquiries as those described are costly and go much above the ordinary activities of the average machine-tool factory. This is not the case. It is a work which in the beginning can be easily carried out in one's spare time. Making a study of foreign markets is a pastime that is not only instructive and entertaining but also very remunerative. It will pay to spend an hour or two a day in preparing the information as indicated above, with a view to making use of it when the opportunity arises. Most of the information can be gained with little cost. The publications of the Government are sold at a very low price, and information can be found in libraries.

A Brake for High-Speed Machines

By Donald A. Baker

In the rapid handling of parts on high-speed machines the momentum of the moving parts of the machine is sometimes a matter to be considered; for instance, on speed lathes, small turret lathes and others where the cutting time is small, the ideal condition is where means of chucking can be provided that do not necessitate stopping the machine. When stoppage is necessary, however, the time required is a big factor in the daily production.

There are many methods in use for accomplishing this stoppage with minimum loss of time. Sometimes a wooden wedge is used between the cone pulley and the machine frame; sometimes a leather brake band is passed around the pulley and pressure brought to bear on it either by pulling it by hand or by carrying it down to a foot treadle on the floor. The method here described is a decided improvement.

We will assume that the machine is provided with the usual type of reversing countershaft having clutch pulleys for open and crossed belts, and that only one of these is required on the work the machine is doing. Place a piece of belt around the idle pulley, carry the ends up to the ceiling, and after stretching it tight fasten it by passing it under a piece of board, which is then screwed to the ceiling. This answers the purpose of a brake band, and the action is as follows: When the operator wishes to stop his machine he throws over the clutch lever, releasing the clutch in the driving pulley and engaging it in the pulley around which the band has been placed. The machine is brought to an immediate stop without undue jar, as of course there is a certain amount of slippage both of the brake band and the machine-driving belt. This is an ideal arrangement as has been proved by thorough trial on a number of current lathes used on time-fuse work where it has given entire satisfaction.

No New School Buildings For New York City

Bernard M. Baruch, chairman of the War Industries Board, has written a letter to Mayor John F. Hylan of New York on the subject of the school-building program that New York desired to inaugurate and which amounted to more than $9,000,000. The case of New York is typical of the whole country, and the board's ruling is intended as a precedent. While agreeing heartily with the necessity of providing for the fullest education of the children Mr. Baruch points out the danger at this time of allowing such plans to militate against the fulfilment of the war program, which is seriously threatened by nonmilitary demands. He asks that methods be devised to make existing buildings do the work during the period of heavy demand for manpower and material, and thus save the available material for purposes of war.

War Sparks from Industry's Forge

Edited by E.C.Porter

Henry Ford, through his private secretary, announced that he will return to the United States Government all the profits he personally makes on war-contract work. He added that he expected a number of the other stockholders of the Ford Motor Co. would follow his example.

* * *

From a statement recently issued by the National War Savings Committee $211,417,942 was raised by the sale of War Savings and Thrift stamps during the month of July. Since the sale of these stamps began $518,510,334 have been paid up to July 31, which represent an investment by over one-third of the country's population.

* * *

An estimate of the quantity of gasoline saved in the states east of the Mississippi River on the first motorless Sunday places it between 100,000 and 150,000 barrels. It is expected that the saving on future motorless Sundays will be much greater when motorists become more familiar with the request.

* * *

Consul Clarence Carrigan, Lyons, France, suggests that it is not too early for American manufacturers and exporters to begin preparations for the 1919 Lyons Fair, which will be held some time in March. The consul intends to hire space at the fair and to exhibit American trade catalogs free of charge as in previous years, and he states that the display of samples rather than catalogs would be preferable wherever this is possible.

* * *

Orders have just been placed by the Quartermaster Corps for 2,300,000 packages of chewing gum for the Army. It has been found that on long marches and where the troops are unable to get sufficient water, chewing gum is very effective in relieving thirst. Recently the commanding officer of a regiment of field artillery, when embarking for oversea service, stated that 250 lb. of chewing gum would save hundreds of gallons of water when most needed.

* * *

Projects for the conservation of material and transportation and the release of capital in the metal-bedstead industry worked out July 15 by the Conservation Division of the War Industries Board with the manufacturers have become effective. These projects comprehend reducing the number of patterns, the designs of springs and the amount of tubing used; also cutting down head and foot ends, discontinuing the joint manufacture of steel and brass beds and the use of brass ornaments on steel beds.

* * *

The Naval Consulting Board has opened an office in Room 3547 in the new Navy Building, Washington, D. C. It is completely fitted out for handling communications and inventions, all of which should be sent there. The office of the chairman and secretary will remain in New York, but the new working office in Washington will be in charge of David W. Brunton, one of the present members of the board. The force will consist of two of the present members and several well-known scientists.

* * *

If all the mines produced by the Navy Bureau of Ordnance since America entered the war were planted the same distance as in regular mining operations they would make a belt that would reach across the Atlantic eight times. Mine production has been so highly developed that there is now a daily output of 1000 mines. This satisfactory condition is the result of the development and standardization by the Navy Bureau of Ordnance of a new type of American mine. The new mine is one of the safest in the world to handle. There has not been an explosion or accident, either in loading or in laying them, yet they have proved to be a tremendously potent antisubmarine weapon. The mine is so constructed that should it break adrift from its anchor it would immediately be rendered inactive by internal mechanism, which also causes it to float on the surface where it can easily be destroyed. Should a ship strike one of these floating mines the firing mechanism would not function.

* * *

From the beginning of the war to June 30, 1918, the last day of the past fiscal year, contracts totaling $4,300,000,000 were placed by the Ordnance Department of the United States. The estimate for the current year is over $7,000,000,000. The major items of last year were as follows: Artillery, $1,050,000,000; automatic rifles, $300,000,000; small arms, $100,000,000; artillery ammunition, $1,900,000,000; small-arms ammunition, $340,000,000; small-arms ammunition (practice), $80,000,000; stores and supplies (personal, horse and organization), $230,000,000; armored motor cars, $100,000,000; total, $4,100,000,000. Some other expenditures by the War Department were $375,000,000 for engineering operations mostly in France, $37,000,000 for flour, $145,000,000 for sugar, $43,000,000 for bacon, $12,000,000 for beans, $9,000,000 for tomatoes, $2,000,000 for rice, $47,500,000 for rolling kitchens, $127,000,000 for shoes, $565,000,000 for clothing and $147,000,000 for blankets. Some smaller expenditures were over $6,000,000 for axes, $1,635,000 for field stores, $2,700,000 for carpenter and $224,000 for blacksmith tools and $2,500,000 for shovels. The department has bought 266,000 wagons and carts costing $37,000,000, and 410,000 horses and mules costing $99,000,000; food for them cost $62,000,000 and harness $29,000,000. These are only some of the figures. They seem large, but not so large when it is remembered that we have nearly 2,000,000 men in France and almost as many in training here at home. All of this money and all the other money raised by the Liberty loans go to make our Army, our Navy and our people powerful and victorious in their war for freedom and right.

A Problem in Worm Gearing

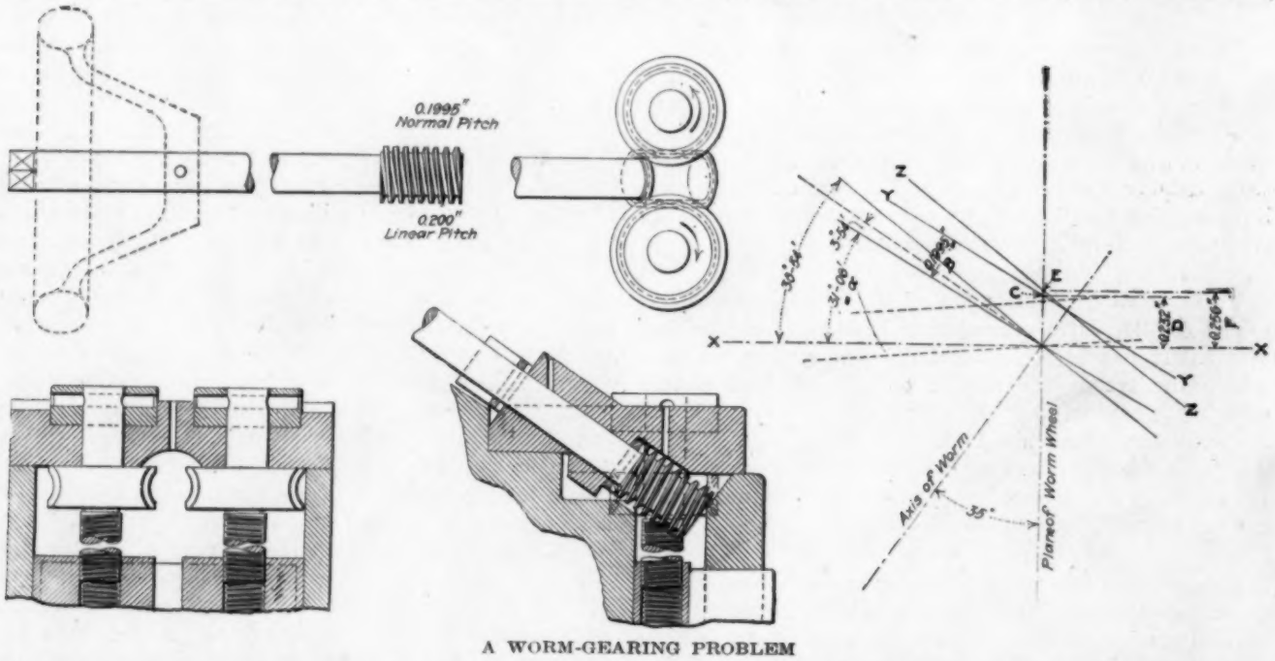
By R. A. Monte

In view of its unusual features and peculiarities of design that are not at once apparent the writer submits the following description of a set of worm gearing which recently came under his observation in order that designers who may be called upon to solve similar problems may guard against the hidden pitfalls that caught the unwary sponsors of this piece of mechanism.

At first sight it did not seem to offer unusual difficulties, and the manager of a well-known gear-cutting firm, to whom the sketch was shown, pronounced it feasible and accepted the order for cutting the worm and wormwheels. A little later, however, the writer was called into the office of the gear works, where he was confronted with a badly gashed up pair of wormwheel blanks and presented with a little gratuitous advice on the subject of worm gearing.

Looking at the drawing it will be seen that the problem is to drive in opposite directions two wormwheels lying on opposite sides of a worm whose axis is inclined at an angle of 35 deg. to the plane of the wheels. By reason of this departure from the usual practice it becomes necessary to figure the face angle for each wormwheel separately, for instead of the helix angle and angle of face being equal for both wheels, as would ordinarily be the case, the face angle of one wheel would be 35 deg. plus the angle of helix, and the other would be 35 deg. minus this angle, and since the normal face angle is much less than 35 deg. one of the wheels will have become of the opposite hand.

To find the helix angle of the worm by the formula we have $\tan \beta \frac{P}{d}$ thus: $\frac{0.200}{2.937} = 0.06809 = 3$ deg. 54 min., and as linear pitch $\times \cos \beta =$ normal pitch thus: $0.200 \times 99768 = 1.995 =$ normal pitch. The normal



A WORM-GEARING PROBLEM

pitch of the wormwheels will of course be determined by the worm, but their actual linear pitches, and consequently their diameters, must be computed from the face angle β, which as stated above will be peculiar to each wheel.

As the linear pitch is represented by $\frac{\text{normal pitch}}{\cos \alpha}$ and as α equals 35 deg. $+ \beta$ in one case and 35 deg. $- \beta$ in the other we have $\frac{0.1995}{0.77825} = 0.256$ in. as the actual linear pitch of what we will call the right-hand wheel and $\frac{0.1995}{0.85628} = 0.232$ for the same factor

for the left-hand wheel. Calculating for diameters of the wheels upon this basis we have for the right-hand wheel $\frac{0.256 \times 22}{\pi} = 1.795$ in. and for the left-hand wheel $\frac{0.232 \times 22}{\pi} = 1.624$ in.

It requires some little courage to make a confession like the above, and I expect it will give rise to a poor opinion of our gear-designing ability; but as it is by our own and others' shortcomings that we learn, the writer hopes that this acknowledgment will induce others of the trade to set down on paper their own failures, which would doubtless prove highly interesting and instructive.

Keeping the Grease Supply Clean

BY J. A. LUCAS

A scheme for keeping dust and grit out of grease that is used to some extent for lubrication in most machine shops is outlined in the sketch. The usual practice is

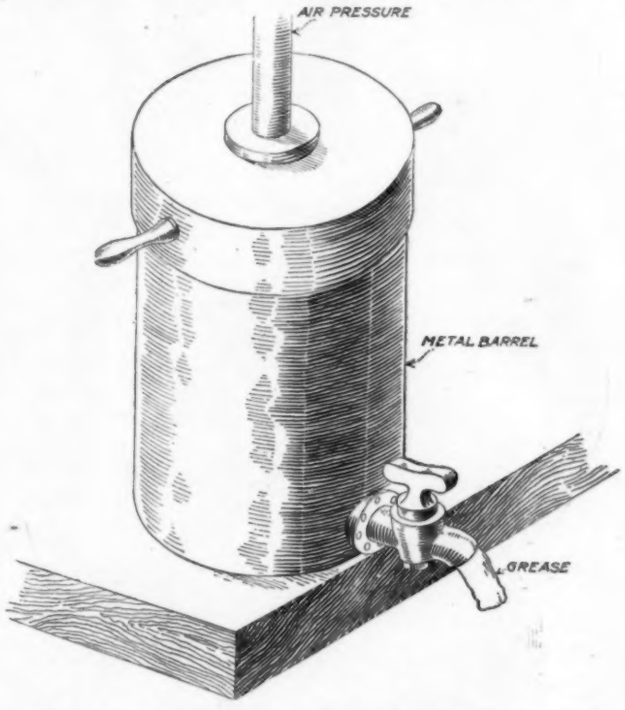


FIG. 1. COMPRESSED AIR FOR THE GREASE SUPPLY

to keep this material in a loosly covered can, removing the cover and dumping a week's accumulation of dirt and chips into the grease every time the bearing cups are to be filled, the result being often a hot box or a scored bearing from an unsuspected cause.

To prevent this possibility an iron container is provided, as shown in Fig. 1, with a screwed cover which is tapped for the introduction of a small pipe leading from the air line which is generally a part of the modern shop's equipment.

To obtain a supply of grease, open the plug at the bottom of the container and turn on the air. The same method may be applied to oil barrels located in the basement to deliver oil to the tool crib on the floor above, as in Fig. 2, or to any point convenient for the filling of the small cans.

[In our shop days we at one time experienced difficulty in drawing "winter-strained" lard oil from the barrel that was stored in an unheated outbuilding, and there being no compressed-air supply available, a small hole was drilled and tapped in the bung to fit the connection

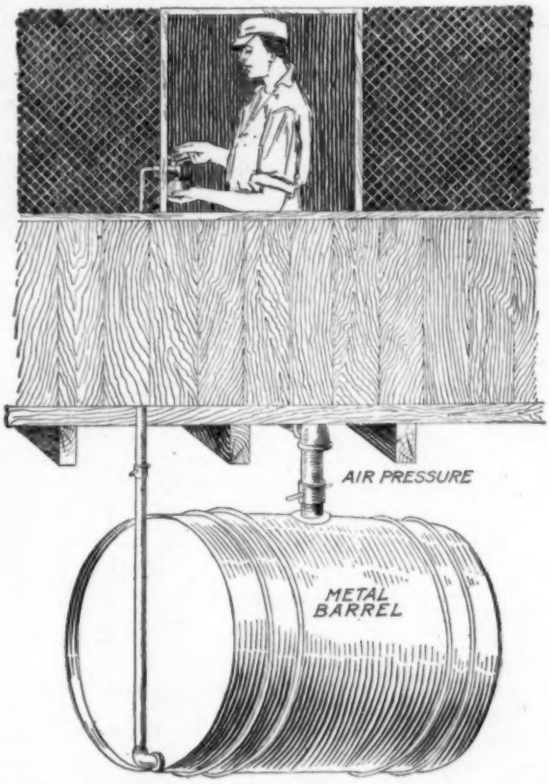


FIG. 2. LIFTING OIL TO A CONVENIENT POINT FOR FILLING THE SMALL CANS

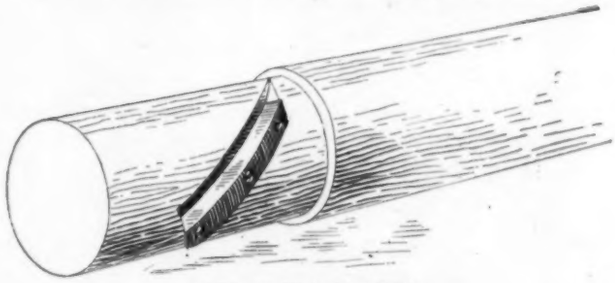
of an ordinary bicycle footpump, the bung then being driven into place in the barrel. This enabled the boy to go out any cold morning and secure a yard or two of lard oil whenever it was needed.—Editor.]

An Emergency Reamer

BY F. E. POTTER

Our millwright recently had occasion to ream the cast-iron sleeve of a clutch on our main drive, and as time was an important factor the reamer here described was improvised.

The sleeve was 22 in. long and $3\frac{7}{16}$ in. bore, from



IMPROVISED REAMER

which 0.007 in. of metal was removed in about half an hour of actual reaming.

He first turned a piece of hard wood 30 in. long to fit the hole to be reamed and inserted a cutter as shown in the illustration. The necessary curvature of the cutter

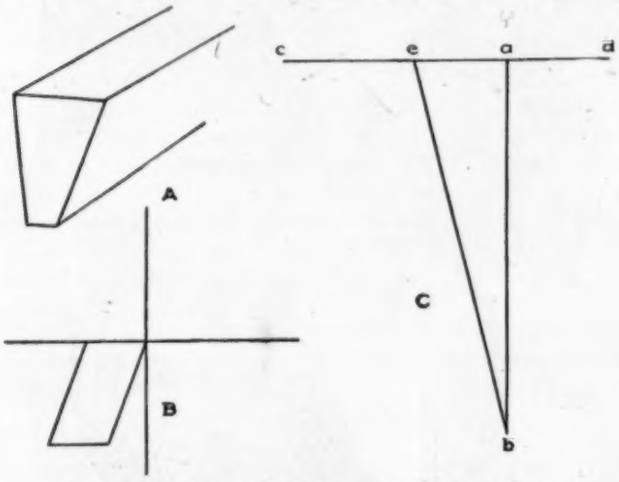
was secured by forming it over a piece of pipe of the proper diameter to make it fit the recess chiseled in the bar. The cut was adjusted for size by packing tissue paper under the cutter.

Angles for Square-Threading Tools

By George F. Kuhne

When cutting square threads some workmen are inclined to grind the tool as shown at *A*, and while favorable results are sometimes obtained, the sketch *B* will enable the mechanic more readily to obtain the requisite clearance or angle.

The sides of the cutting tool must be inclined from a vertical line, the amount depending upon the diameter



ANGLES FOR SQUARE-THREADING TOOLS

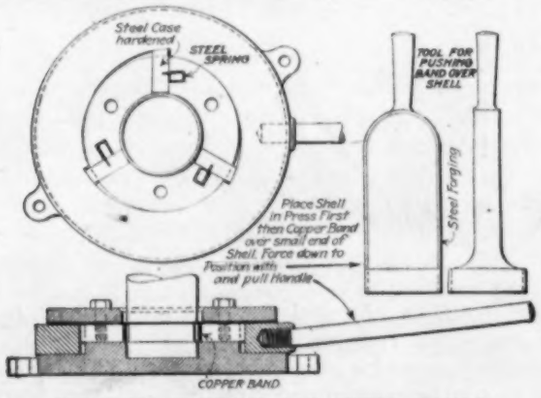
of the screw and the pitch of thread. The inclination of clearance may be obtained as shown at *C*.

The line *ab* is vertical and at right angles to *cd*, and in length is equal to the circumference of the root of the thread. On *cd* lay off the point *e* a distance from *a* corresponding to the pitch of the thread. The line *be* represents the angle of the side of the thread. To insure sufficient clearance for the tool the side angle of the tool should be greater than the line drawn.

Crimping Fixture for Shell Bands

By A. F. White

The drawing shows a fixture for crimping the copper band in position on 3-in. shells as a preliminary operation to forcing them in on the hydraulic press.


Steel Case hardened
STEEL SPRING
TOOL FOR PUSHING BAND OVER SHELL
Steel Forging
Place Shell in Press First then Copper Band over small end of Shell. Force down to Position with and pull Handle
COPPER BAND

CRIMPING FIXTURE FOR SHELL BANDS

The shell is placed in the fixture, the band dropped over it and pushed down with the tool provided for the purpose. Pulling the lever attached to the cam ring then forces the three jaws inward, crimping the band accurately in position.

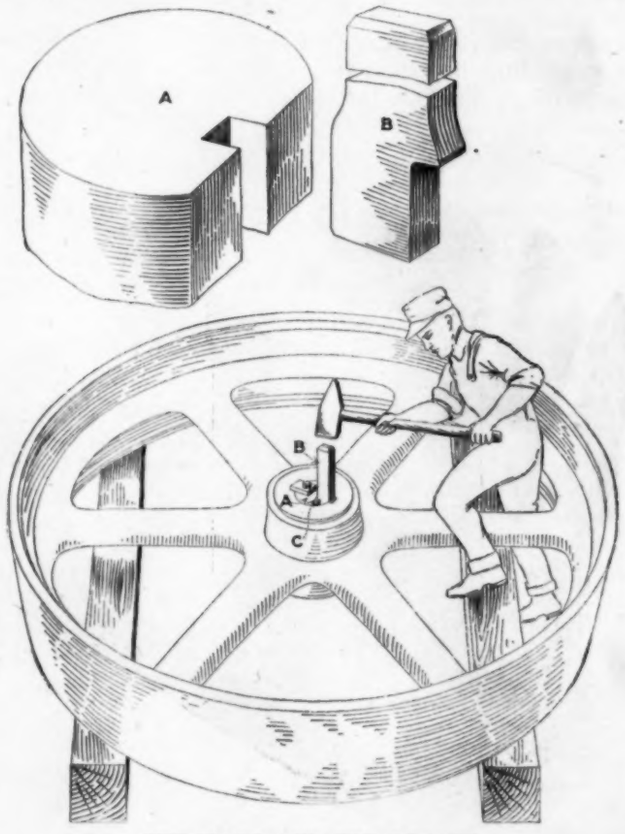
The whole operation requires about ten seconds for its accomplishment.

Cutting a Keyway on a Large Pulley

By A. J. Lacul

Having occasion to cut a keyway in a pulley that was too large to be handled by the usual methods where a keyseating machine is not available I devised the kink shown in the cut.

Take any piece of round iron *A* to fit the bore of the pulley and cut a keyway in it to match the one



THE WORK AND THE BROACH

desired in the pulley, but deep enough to cover the broach *B*, which should be made a sliding fit.

By packing under the broach at *C* with successive pieces of tin or other sheet metal and keeping the broach well lubricated a good keyway may be cut in the pulley in a very short time.

In our case the broach was driven through with a hammer as the work was too large to get into an arbor press.

Fixture for Milling Slots in Levers

By Christian F. Meyer

In Fig. 1 is shown three levers which are to have a milled slot, the dimensions of which are different for each piece. The length and diameter of the hubs

as well as the bore vary with each lever as does the distance between centers of hub and slot.

The fixture, Fig. 2, was made to provide a practical quick-acting and accurate means of milling these slots in any lever of similar design regardless of difference in dimensions. A cast-iron baseplate *A* has at one end the supporting bracket *B*, as shown, while the opposite end is fitted with a slide *C* which may be moved in a horizontal direction by means of the screw and crank handle. A hardened pin *D*, the diameter of which corresponds with the smallest bored lever to be slotted, is securely fastened in the center of this slide, and the slide is located in whatever position may be required by stops *E*, the ends of which are tapered and fit into holes in the slide. These stops are positioned to correspond to the length of the levers which are to be milled.

To use the fixture the slide is set so that the distance from the center of the pin *D* to the center of locating screws *F* corresponds with the length of the lever to be slotted. Bushings are provided to slip over the pin and fasten to same by a headless setscrew. The outside diameters of these bushings are made to suit the various bores, and each bushing is provided with a collar or head so that it may be held at any desired height to accommodate the length of boss of the lever to be operated upon.

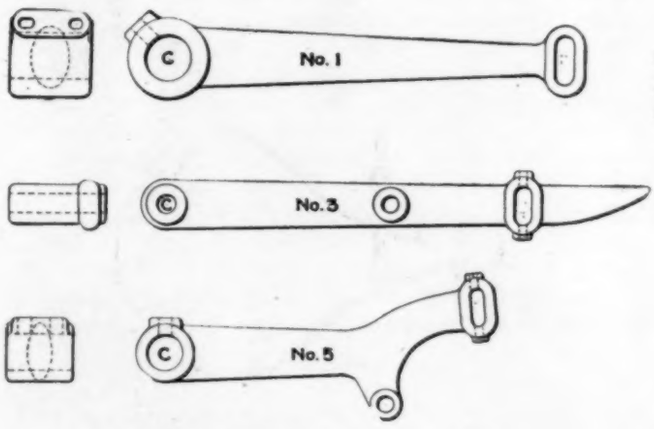


FIG. 1. LEVERS TO BE SLOTTED

The part to be slotted is located and held by screws *F*, and a gage is provided to set the cutter to coincide with center of these screws, thus the respective levers will be alike and, therefore, interchangeable.

A screw *G* in the swinging arm *H* holds the work and prevents chattering. This arm is provided with a slot so that it may be swung out to facilitate the location of the work. For the same reason one of the adjustable screws *F* is so mounted that it may be turned back out of the way, while the other is held stationary by a locknut after it has been once set to suit the lever to be slotted. A suitable opening is provided for the escape of chips. It will be seen that a fixture of similar construction may be adapted to a large variety of similar work.

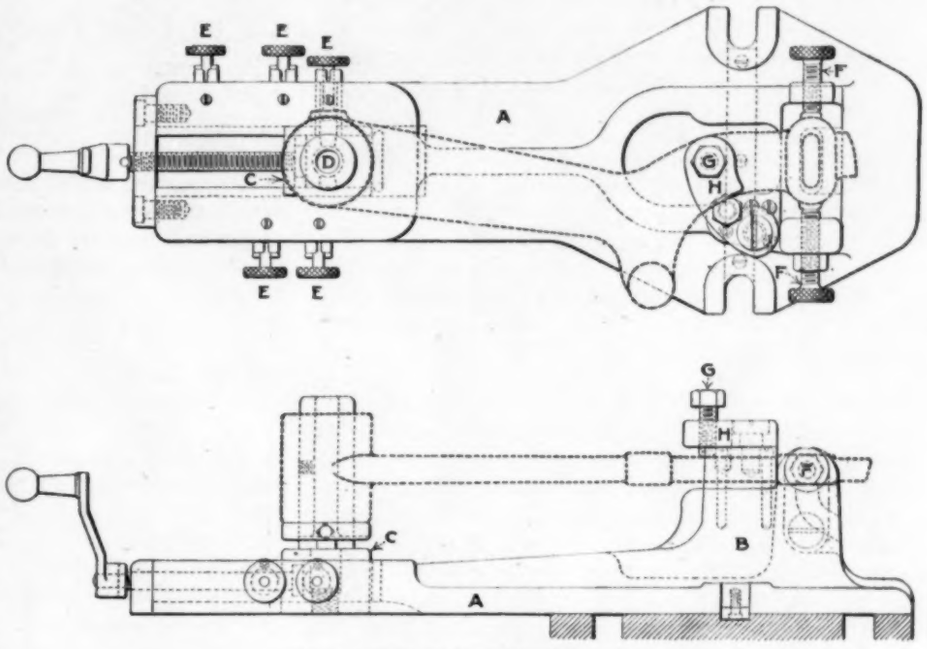
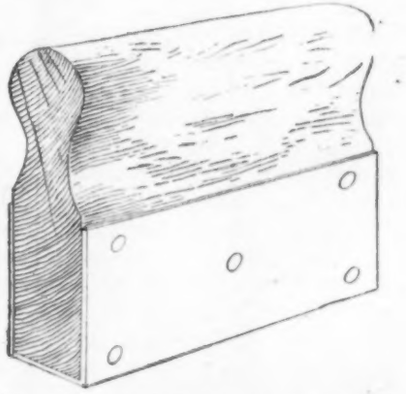


FIG. 2. THE SLOTTING FIXTURE

Blotting Out Dimensions on Blueprints

BY ARNOLD MERRIT

It is frequently necessary to blot out dimensions, etc., on blueprints and bills of material. A good way to accomplish this is to cut a pine block so that its end dimensions will be about the same as the space which it is desired to blot out and fold a strip of blotting paper over this end in the manner indicated in the sketch, and fasten with thumb tacks. When moistened with the bleaching solution and pressed down squarely on the print it whitens the spot exactly where it is required, leaving the edges sharp and thus presenting a much neater appearance.

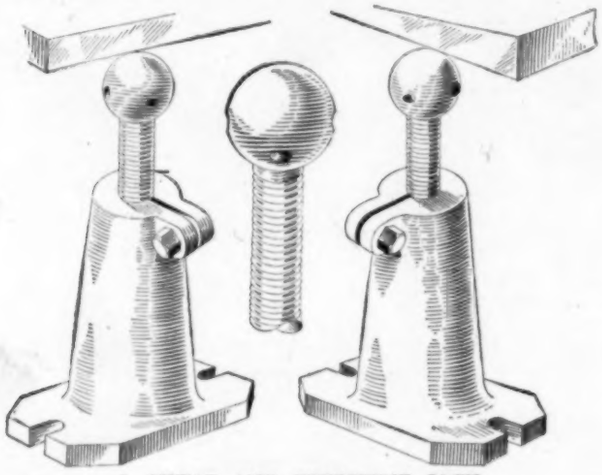


PAD FOR BLEACHING BLUEPRINTS

A Handy Jack from Scrap Parts

By J. A. Lucas

Having available several press-gate adjusting screws of the type having a ball on one end, which were worn too badly to be of further service in their original capacity, I made use of them by tapping out sundry castings to fit them, and as a result I have a number



A CHEAP AND EFFICIENT JACK

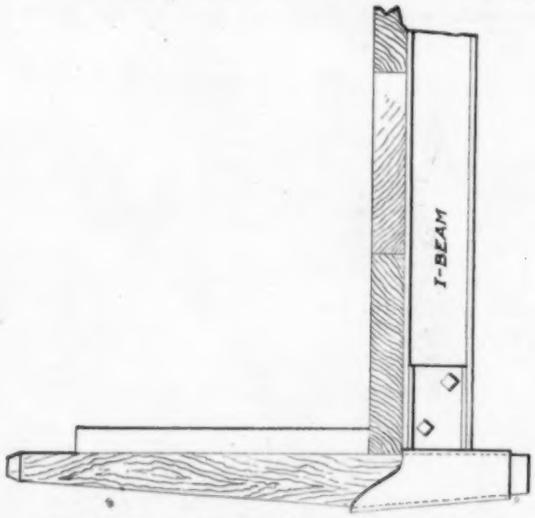
of handy and serviceable jacks to use around the shop. The hardened ball on the end obviated the necessity of providing swiveling heads.

The cut shows a jack made with a casting purposely designed for it, which is of course desirable, but many times pieces of casting such as pulley hubs, etc., may be made to serve.

Improved Pockets for Truck "Stakes"

By M. E. Duggan

Did you ever notice a new automobile truck passing down the street, "stakes" as erect as a company of



IMPROVED POCKET FOR TRUCK STAKES

soldiers for the first two weeks that the truck is in service? After about the third week these stakes and side boards will resemble the rear wings on an airplane. The stakes are about 30 in. high, the side pressure about 1 ton, and the stake pockets only about 1½ in. deep.

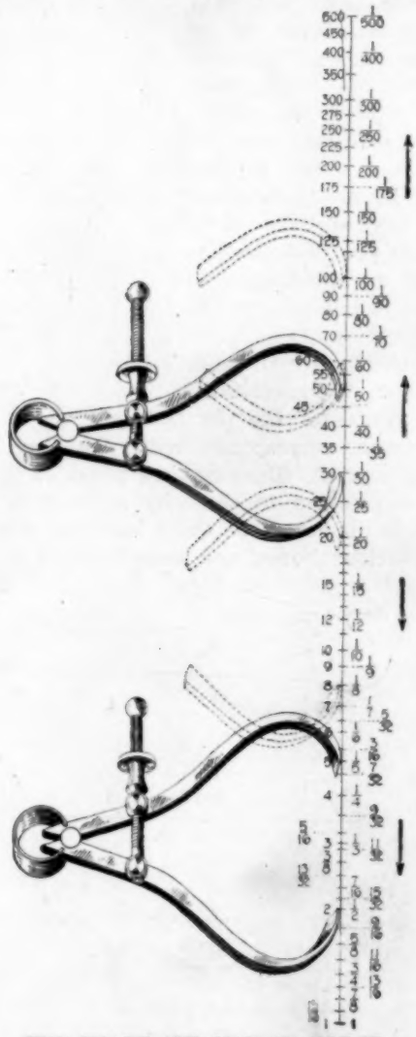
In the sketch is shown the design of a stake holder, made of malleable iron, light in construction and which properly fastened to the ends of the wooden or metal framework of the truck will forestall this trouble.

Chart for Finding Time Required to Turn Work*

Compiled By R. Poliakoff

Assistant Professor of Mechanical Technology, Technical Institute, Moscow, Russia

To use the chart, take the vertical distance between the revolutions per minute on the left side of the column and the feed in inches on the right side. From the left side select the number corresponding to the



THE CHART AND HOW TO USE IT

length of the work to be turned. From this number set off the distance previously taken and the result will show on the left side the time in minutes required to turn the work.

If in taking the distance the feed is below the r.p.m. then read downward to find the time, and vice versa. Example 1—R.p.m., 20; feed, ⅛ in.; length of work, 5 in.; time, 2 minutes.

Example 2—R.p.m., 30; feed, $\frac{1}{16}$ in.; length of work, 60 in.; time, 100 minutes.

*Copyright, 1918, by R. Poliakoff.

EDITORIAL COMMENT

Make It 100 Per Cent.

THIS week we load the gun for the fourth shot at the already toppling dynasty of the Hohenzollerns. Each succeeding Liberty Loan has found us less and less of a collection of nationalities gathered from the four quarters of the globe and more and more a welded unity of Americans. This Fourth Liberty Loan will go further to perfect this weld than any of the previous three. It will be oversubscribed without a doubt, but its success as an indication of the unity of purpose of the American people will not be in its oversubscription so much as in a 100 per cent. individual representation.

There is no man in your shop from the president of the company down to the floor sweeper whose future success and happiness does not depend on our boys winning this war. There is no one between these high and low limits of station, and including them, but who lies under heavy obligation to his country to buy a bond.

Machine shops in particular have special obligations in this matter; nine-tenths of the implements of modern warfare are made in and by them. The larger part of the billions of dollars secured by these very Liberty Loans find their way back into machine shops in payment for the making of these implements of war. The resources and savings of America are being poured into American machine shops, where gold is transmuted into steel for fighting purposes. This wealth distributed in the form of wages must in large part be loaned back to Uncle Sam through the purchase of Liberty bonds. Every wage earner in a machine shop who buys a Liberty bond not only is doing his duty by his country and by his comrades in arms but is helping to keep himself supplied with work.

In laying out your campaign for the Fourth Liberty Loan drive in your shop aim at 100 per cent. representation—and get it. Don't be satisfied with 1 per cent. less.

The *American Machinist* will print on a roll of honor the names of all American machine shops achieving 100 per cent. representation on the Fourth Liberty Loan.

Is *your* shop 100 per cent. American? Prove it!

Bigger Foremen Coming

AS YOU pull into the Broad Street station of the Pennsylvania Railroad in Philadelphia you may by glancing out of the car window at the proper moment perceive a sign which says "Largest street-cleaning contractor in the world." This is rather an ambiguous sign and leaves some question in your mind as to whether the largeness aforesaid is physical, mental or financial. There is no doubt that foremanships in American machine shops are daily growing bigger in their requirements. It is going to require big men to fill them; not physical bigness in this case but bigness of general caliber, disposition and ability.

The foreman of today holds the most important position in industrial life. I believe there is no exaggeration in this statement. As the point of contact between the employer and the employed his position is such as to require the sanest kind of thinking; his acts can do vast amount of good, or unmeasurable harm.

Upon the foreman depends very largely the presence or absence of labor trouble. Upon him depends largely if not entirely the efficiency with which various departments are conducted. Upon him depends the earnings of the company and its stockholders and the earnings of the workers.

As the dilution of skill continues in American shops during the coming years, as it must, and the untrained has to be trained to do work that was formerly classified as highly skilled labor, the qualities required for foremanship will become more and more exacting. It is comparatively easy for one man to supervise 20 or 30 skilled workers to whom a word is sufficient indication of what is wanted, but it is a different matter when this long-standing skill must be replaced by hastily trained workers formerly wholly unacquainted with the trade. These new problems will require careful study and may very likely call for the specialized training of foremen to meet the new conditions.

The machine-shop foreman of the past generation was a big man, but the machine-shop foreman of the coming generation must be a bigger one.

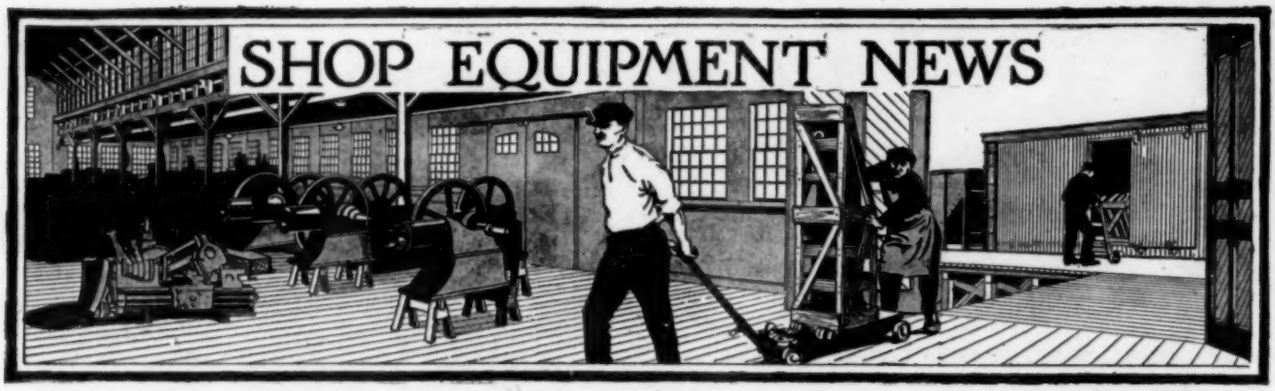
Get out your growing clothes, Mr. Foreman!

Fighting Shop Propaganda

PROPAGANDA is not confined to any one nation or section or sect or sex. It is as old as the hills and as universal as sin. Machine shops have been full of it for years, although machine-shop men may not have recognized it by that name. Sometimes it is directed against the firm; sometimes against the superintendent or a certain foreman; sometimes against a certain worker in the ranks. It is spread through idle gossip. It grows as fast as mushrooms in a damp cellar and is more poisonous in its effect than a bottleful of liberated disease germs. This sort of propaganda would die of starvation if one man refused to credit or pass along an unauthenticated criticism of another.

If you are working for a good firm stand up for it.

John H. Van Deventer



This department is open to all new equipment of interest to shop owners. Photographs and data should be addressed to Editorial Department, "American Machinist"

Barnes Precision Grinding Machine for Milling Cutters

The cutter-grinding machine shown in the illustration is an improved model recently placed on the market by William O. Barnes, Leominster, Mass., and is known as the No. 78 machine. The purpose of the device is to provide a means of standardizing the grinding of complicated gang-milling cutters, whether they have straight, spiral, radial or undercut teeth. Fig. 1 shows the complete grinding machine, while Fig. 2 shows a gang of cutters with its templet, or former plate, mounted ready for grinding the profiles of the teeth. The entire gang is ground completely at a single setting and correct clearance is given to all the side teeth as well as those on the periphery. The machine consists essentially of a plane table with a grinding wheel supported above it, the wheel being adjustable forward and backward by means of a slide and screw. The wheel is carried on a short axle which runs in ball bearings. A tubular former pin projects from the surface of the table and extends upward and carries at its upper end a tooth rest which closely encircles the wheel. The height of this rest is fixed and is at such a distance below the center of the wheel as to give the cutter tooth the required clearance. A wheel-truing device is furnished with the machine, and when in use this is placed against the former pin and swung around it, thus giving the edge of the wheel the same shape as the pin. The truing device also leaves the surface of the wheel in alignment with the templet-guiding surface of the pin, the accuracy of alignment being independent of the diameter of the grinding wheel, this feature being necessary to insure accurate work. The work-holding jig is mounted on hardened feet and carries an arbor on which are assembled the cutters composing the gang, a templet having the required contour being secured to the under side of the jig. After the cutters and templet have been brought into proper position by means of adjustments the teeth are ground by sliding the jig past the former pin with the templet in contact with the pin. Gangs the profiles of which do not contain concave curves of smaller radius than $\frac{3}{16}$ in. are usually ground with a round-edged wheel, the sharp internal angles formed by the juncture of interlocking cutters being secured by separating the cutters by means of washers of standard thickness, the templet being made to correspond. When concave curves of smaller radius than $\frac{3}{16}$ in. must be ground a special small radius sleeve is placed on the former pin and a wheel of corresponding shape

FIG. 1. BARNES PRECISION GRINDING MACHINE FOR MILLING CUTTERS

Capacity: Milling cutters up to 7 in. in diameter and 8 in. long; shank cutters up to 2 in. in diameter and 8¼ in. long and flat form tools up to 7 in. wide.

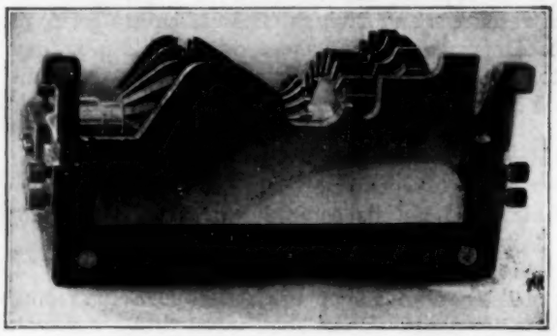
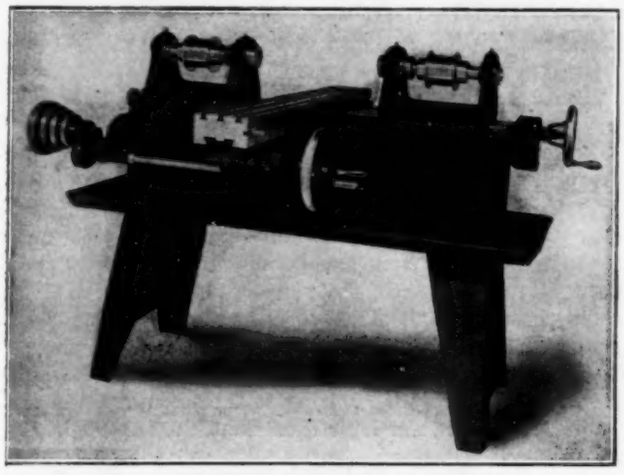


FIG. 2. BOTTOM VIEW OF HOLDING FIXTURE

employed. Full concave semicircles down to zero radius may be ground and sharp internal angles as small as 90 deg. may also be handled. When smaller angles are required they are usually obtained by grinding only one side of the angle on a tooth, the right and left sides of the angles appearing on alternate teeth of the cutter. Provision is also made for grinding away the heel of the tooth when the land becomes too wide for clearance. Attachments are furnished for grinding shank cutters, reamers and also flat form tools for use in screw machines, lathes, etc.

Garvin No. 1X Duplex Milling Machine

The Garvin Machine Co., Spring and Varick Sts., New York City, has recently made an addition to its line of duplex milling machines. The new type is known as the 1X machine, and is shown in the illustration. Simultaneous wheel control of the spindle heads is used so that both heads may be moved at

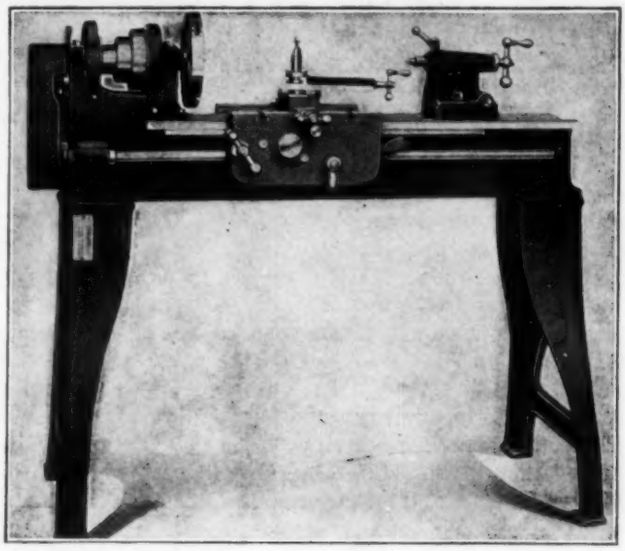


DUPLEX MILLING MACHINE

one time, but provision is also made for independent head adjustment. The feed of the table is 34 in., while the distance between spindle heads is 22 in. It is claimed that this system of milling assures parallelism of the work, and that butt or face cutters give a finer finish to the work. A heavy feed can be used without sacrificing finish. The cutters are placed close to the end of the spindles in order to avoid spring. Fixtures may be attached to the table, which is provided with power feed, automatic trip and quick return by hand-wheel, the changes of feed being by means of a cone pulley driven from the countershaft. The equipment includes pump and piping for cutting lubricant.

Sebastian 10-in. Lathe

The Sebastian Lathe Co., Cincinnati, Ohio, has recently placed on the market the 10-in. engine lathe shown in the illustration. The headstock is said to be amply heavy and well braced and is provided with a three-step cone for a 1¼-in. belt, the back gears being thrown in and out of engagement by means of a cam. A feed reverse is also provided for screw-cutting. The spindle is ground to size and runs in phosphor-bronze boxes, while the tailstock spindle is also ground to size. Taper-turning is provided for by setting over the tailstock which is of the cut-under pattern to allow the compound rest to be swung at right angles. T-slots are provided at both the front and rear of the carriage and power cross-feed is incorporated. The regular equipment includes friction countershaft, steady, follower and compound rests;



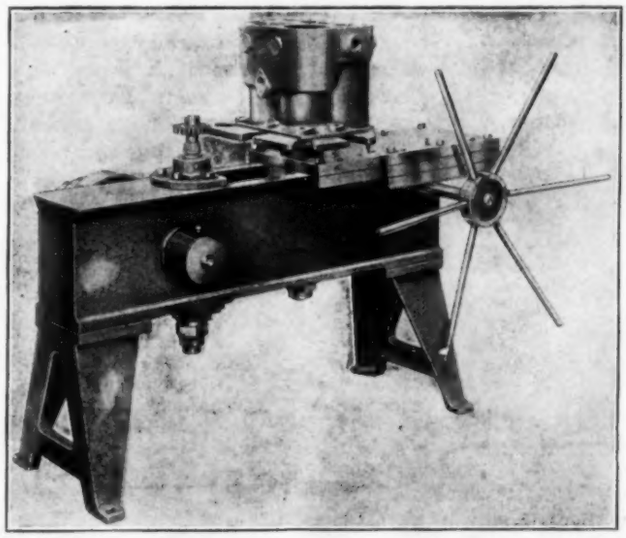
SEBASTIAN 10-IN. LATHE

Swing over bed, 11 in.; swing over carriage, 7¾ in.; length of bed, 4, 5 or 6 ft.; front spindle bearing, 1⅞ x 2½ in.; hole through spindle, ½ in.; cone, three step for 1¼-in. belt; distance between centers with 4-ft. bed, 28 in.; width of bed, 8 in.; depth of bed, 7 in.; weight, 450 lb.; size of tools, ⅞ x ⅝ in.; travel of compound rest, 3¾ in.; capacity of center rest, 3 in.; centers, Morse taper No. 2; threads on spindle nose, 10 pitch.

5- and 9-in. faceplates, wrenches, and gears to cut standard threads from 3 to 40. Extras such as plain tool block, taper attachment, wood- and metal-turning tools, hand rests, raising blocks, special centers, motor-drive arrangement, milling attachments and chucks can be furnished if desired.

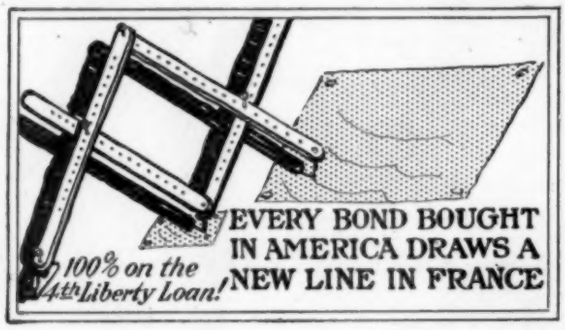
Moline Back-Facing Machine for Cylinder-Base Bosses

The machine shown in the illustration is a back-facing milling machine for the various bosses on cylinders or crankcases of gasoline engines or other



MILLING MACHINE FOR BACK-FACING BOSSES

machine parts. The machine is adapted for all work where the bosses are near enough to the edge of the part to be reached by a milling cutter or not in a sharp angle where milling cutters cannot reach them. The machine consists essentially of a bed, a slide carrying a master plate on a vertical spindle and an inverted-cutter spindle carrying a milling center. The work to be faced is located on the master plate by pins and no clamping is necessary. The master plate has notches around its edge corresponding in location to the bosses to be faced. These notices are engaged and guided by a roller mounted on the cutter spindle below the cutter. After the work has been placed on the master plate the notches are brought successively in line with the guide roller and the work advanced to the cutter by means of the pilot wheel shown projecting from the front. The cutter spindle has vertical adjustment to allow for wear of the cutter and for different heights of bosses and is driven by spiral gearing. The vertical spindle for the master plate has ball thrust bearings in order that it may be easily revolved. The machine is the product of the Moline Tool Co., Moline, Ill.



The Other Side of the Decimal Point

BY ALONZO G. COLLINS

The article under the above title on page 387 of the *American Machinist* reminds me of an incident in which an engineer did just such a stunt as the fellow that paced off the diameter of the tank. I know, for I was one of the assistants on the case.

We were engaged in making an evaporation test of a boiler when, as will sometimes happen, the glass water gage on the boiler broke. Of course the operating engineer shut the connections as soon as possible, but there was an appreciable lapse of time, during which steam and water were blowing from the disabled fixture.

No one held a stop watch on the affair, and no one at the time gave much thought to how long the steam and water were being wasted, but in his report the engineer assumed the time during which water and steam were being blown away to be so many seconds, and calculated and credited the boiler with an amount of lost water figured to four places of decimals!

Meeting of the American Gear Manufacturers' Association

The semi-annual meeting of the American Gear Manufacturers' Association was held at the Onondaga Hotel, Syracuse, N. Y., Sept. 19-21. President F. W. Sinram presided, the other officers being H. E. Eberhardt, vice president, and F. O. Hamlin, secretary-treasurer. Several interesting papers were read. W. H. Diefendorf of the New Process Gear Corporation gave an address on "What is the Possibility of Women Becoming a Permanent Factor in the Gear Industry?" C. E. Stuart of the Central Steel Co. gave one on "The Outlook of the Steel Supply" and C. E. Crofoot of the Crofoot Gear Works on "Trade Acceptances." The attendance was very good and the delegates thoroughly enjoyed the various shop visits and social features.

Motor-Vehicle Engineering Course

The Cooper Union has added a motor-vehicle engineering course to its night-school courses. This course is specially designed for those who are engaged during the day in automobile construction or repair, in automobile-testing departments, in drafting and designing or in some branch of engineering, and wish to obtain a thorough knowledge of motor-vehicle engineering. The object of the course is to fit men for positions of higher responsibility and it includes classroom work, where a study of the principal parts of motor vehicles and the theory underlying their proper design and construction will be given.

The laboratory work will consist of the study of the operation of engines and the causes affecting the indicator diagram, how to determine faulty design and construction from such diagrams, etc. The testing of engine power by Prony brakes and dynamometers, the study of magnetos, efficiency of transmissions, differentials, bearings and other parts of motor vehicles will also be included. The instruction is free, but the laboratory fee is $10. The course will be conducted by Ethelbert Favary. Apply by writing to the secretary, Cooper Union, New York, not later than Sept. 20.

Navy Gas-Engine School Wants Men

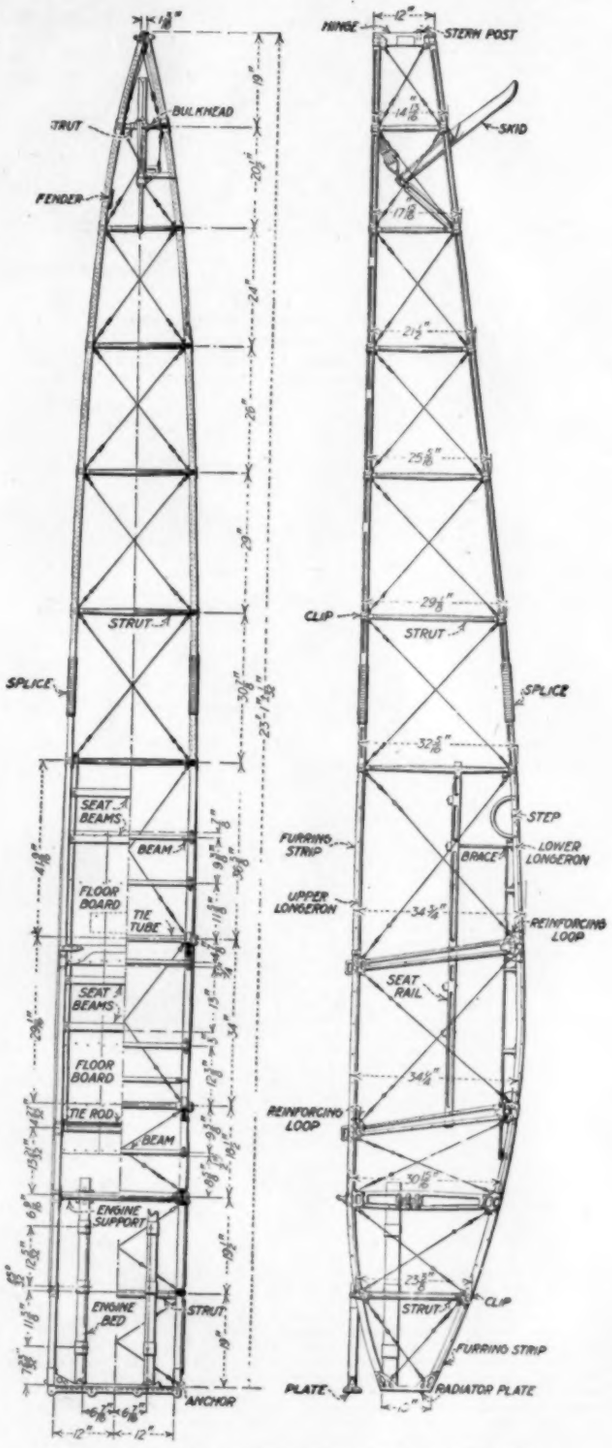
The United States Navy Gas Engine School, of which Lieut. Commander Charles E. Lücke is director, at Columbia University, New York, desires to obtain the names and addresses of men who wish to enroll for training for the positions of chief engineer, warrant machinist and chief machinist mate on board the new submarines of the United States Navy. Applicants must have had extended experience in operating Diesel or other heavy-oil engines. They must be capable of taking charge of such engines and making ordinary repairs and be competent to foresee trouble and maintain the engines in efficient operation. Only those possessing these qualifications will be considered. The ages of the applicants are from 21 to 35, but men up to 40, if well qualified, may apply. The pay is attractive and the training which the applicants will undergo fits them for positions of larger responsibilities. Names and addresses should be sent to Lieut. Commander Lücke, Columbia University, New York.

Machinery Club Holds an Outing

The Machinery Club of Chicago held its annual outing at Thatcher Grove on Saturday, Sept. 14, 1918. The machinery men defeated the supply men at baseball by a score of 13 to 12.

Construction of the Curtiss Military Training Plane

The illustration shows so plainly the construction of the fuselage, or body, of a Curtiss training plane that comparatively little description is necessary. A careful study of this, together with the fittings shown in the



DETAILS OF CURTISS TRAINING MACHINE

article on page 253, will give a better idea than can be had from either view by itself.

The radiator plate, or fitting which goes across the front end of the fuselage framework and ties the four longerons together, adds considerably to the stiffness of the whole front of the structure and makes it a much better support for the engine, which is bolted down to the horizontal pieces known as the engine bed and shown in the upper view.

This view also gives a good idea of the various fittings used where the struts join the longerons and the way in which the truss or tie wires are put in place. The tension of each is regulated by a substantial turnbuckle, and it is very necessary to keep them properly tuned in order to hold the frame in a correct position. The cross-bracing shown in the upper view is necessarily omitted in that portion of the body containing the feet of the pilot and the student aviator or observer.

The lower fittings also show some of the wing connections, while the upper longerons contain the fittings which support the lower end of the wing struts of the center panel.

Although this may look like a simple construction it is absolutely necessary to have the longerons correctly lined up, to have the proper compression on the various struts, and the correct tension on the tie wires in the different panels. This part of the airplane can be rapidly constructed, but it requires great care, as the presence of a single flaw may not only cause the death of an aviator but in a plane used for battle purposes it may also prevent the necessary information being returned to our lines and may affect the outcome of a battle. Extreme care must always be the watchword in airplane construction.

College Course for Military Service

Complying with the War Department's request that universities and colleges formulate intensive specialized three-months' courses for instruction in the Students Army Training Corps a faculty committee of the School of Applied Science of New York University has worked out eight higher specialized courses for men selected for certain branches of the military service. They are radio communication, testing explosives, testing oils and fuels, testing materials, metallurgical testing, electric power and distribution, military bridge building and military road making. The War Department purposes a great number of higher specialized courses. When a member of the Students' Army Training Corps shows aptitude for specialized training in a certain line he will be transferred to another college or university.

Automobile Shows Canceled

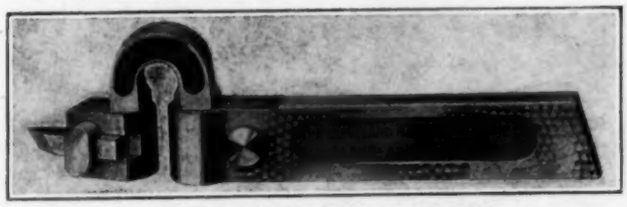
At the request of Bernard M. Baruch, chairman of the War Industries Board, and George N. Peek, Commissioner of Finished Products, the National Automobile Chamber of Commerce has canceled the automobile shows of 1919, which were to be held in January and February in New York and Chicago. Going further to meet the views of the War Industries Board the automobile-industry leaders have urged promoters of local shows for automobiles, trucks or accessories to abandon all plans for such during the coming winter. The reason given to the industry for this action by the Automobile Chamber of Commerce is a desire to coöperate with the War Industries Board in conserving fuel, labor and transportation.

Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Toolholder, Spring-Head

Cleveland National Machine Co., Cleveland, Ohio



"American Machinist," Sept. 12, 1918

This toolholder is intended for finishing work only, the spring head relieving chatter and giving a smooth cut. The spring may be turned in the body of the holder and adjusted to 90 deg. either right or left, and the tool clamp swings on the spring and can be inverted in order to place the tool on the side desired. Three tool clamps are furnished, one taking ¼ x $\frac{5}{16}$-in. flat stock, one $\frac{5}{16}$ to $\frac{7}{16}$-in. round stock and one $\frac{7}{16}$-in. square stock. Tool bits can be used down to ⅝ in. in length and parting tools as thin as 0.014 in. can be held. At present it is made in one size, ¼ x 1$\frac{1}{16}$ x 6 in.

Furnace, Gas, No. 650

Johnson Gas Appliance Co., Cedar Rapids, Iowa

"American Machinist," Sept. 12, 1918

For heat-treating, tempering, casehardening or annealing any piece of carbon tool steel within its capacity. Is equipped with six burners and requires no air blast to produce a temperature of 1800 deg. F. Dimensions of firebox, 13½ x 8 x 5 in.; gas consumption, 75 to 85 cu.ft. per hour; size of front opening, 5 x 8 in.; back opening, 3½ in. square; net weight, 245 lb.; supply pipe, 1¼ in.; height over all, 54 in.

Index Centers, Universal, "Schipper"

C. F. Kern, 26 Hulbert Block, Cincinnati, Ohio

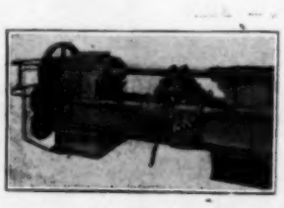
"American Machinist," Sept. 19, 1918

The head is universal and can be set at any angle from 10 deg. below the horizontal to 10 deg. beyond perpendicular, and can be rotated on the base to any angle. The swing on the centers is 10½ in. and the index plates divide all numbers from 2 to 400 inclusive. The spindle is provided with an adjustable taper bearing at the rear end, and the clamp ring relieves the worm and wormwheel and index head from all cutting stress. Both head and tail ends are fitted with ⅝-in. tongues to fit the standard slot in milling-machine tables, but special tongues can be furnished.

Lathe, Shell-Boring "Galloway"

A. R. Williams Machinery and Supply Corp., Fidelity Bldg., Buffalo, N. Y.

"American Machinist," Sept. 19, 1918

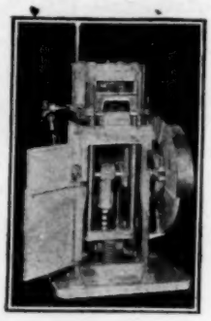


Swing over bed, 30 in.; width of bed over ways, 32 in.; depth of bed, 18 in.; length of bed, 10 ft.; length of carriage, 30 in.; width of bridge, 20½ in.; length of profile slide, 32½ in.; greatest distance between face of spindle and tailstock, 4 ft. 4 in.; diameter of drive pulley, 22 in.; width of belt, 6 in.; size of tool bar, 4 x 4 in.; width over ways, 7 in.; floor space required, 3 ft. 6 in. by 12 ft. 6 in.; approximate weight, 14,000 lb.; rear spindle bearing, 6 x 15 in.; front spindle bearing, 11 x 15 in.; internal bore of spindle, 7 x 22½ in.; length of main spindle, 48¾ in.; hole through spindle, 2¼ in.; diameter of drive gear, 35 in.; gear ratio, 6 to 1; speed of drive pulleys, 110 r.p.m.

"Dying" Machine for Sheet-Metal Work

Henry & Wright Manufacturing Co., 760 Windsor St., Hartford, Conn.

"American Machinist," Sept. 12, 1918

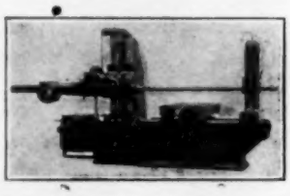


This machine is for blanking, piercing, forming, coining or drawing sheet metal. Weight, 1350 lb.; rated capacity, 25 tons; throw, 1½ in.; adjustment, 2 in.; distance between under side of top plate and working surface of machine when upper plate is raised to its highest point, 10½ in.; distance between vertical shafts, 8 in.; hole in center of working surface, 6 x 7 in.; diameter of flywheel, 24 in.; face of flywheel, 4 in.; weight of flywheel, 300 lb.; diameter of crankshaft, 3 in.; diameter of vertical steel shaft, 2 in.; floor space, 24 x 21½ in.; height of machine over all, 52 in.

Boring, Milling, Drilling and Tapping Machine, No. 5

Defiance Machine Works, Defiance, Ohio.

"American Machinist," Sept. 12, 1918

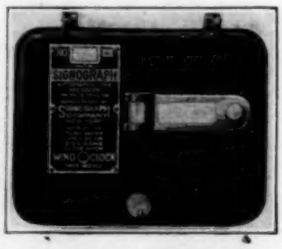


Diameter of spindle, 3 in.; travel of spindle, 24 in.; maximum distance from face of spindle sleeve to face of tail block, 5 ft.; maximum distance from center of spindle to top of platen, 25 in.; maximum distance from center of spindle to top of bed, 33½ in.; vertical adjustment of spindle head, 24½ in.; number of speed changes, ten, 15 to 336 r.p.m.; number of feed changes for spindle, spindle head, saddle or platen, twelve, 0.003 to 0.375 in. per spindle revolution; dimensions of boring bar regularly furnished, 3 x 68 in.; working surface of platen, 24 x 48 in.; cross-feed of platen, 40 in.; longitudinal adjustment of saddle, 36 in.; distance from top of bed to top of platen, 8½ in.; weight, belt drive 11,710 lb., motor drive 12,110 lb.; floor space, 108 x 156 in. Specifications for vertical milling attachment: Travel of spindle head along rail, 48 in.; maximum distance from top of platen to face of vertical spindle, 18 in.; speeds 7½ to 168 r.p.m.; feeds, 0.008 to 0.750 in.

Time Recorder

Sinograph Co., Inc., 412 Eighth Ave., New York City

"American Machinist," Sept. 19, 1918

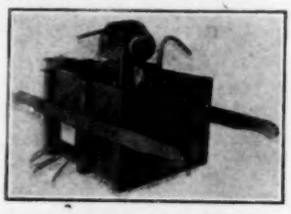


This device is suitable for shops or offices, or where the number of persons for each recorder does not exceed 50. The device measures 9 x 7 x 3½ in. and the person registering signs his name through the small writing window, which is nominally closed by a metallic frame containing a celluloid window showing the name of the last person signing. Consists mainly of an eight-day-clock movement, a metallic printing dial 4½ in. in diameter driven by the clock and making a full revolution in 24 hours. The hours are engraved on this dial facing toward the paper which passes from one roller to another over a portion of the dial, hours during the day being in Arabic numerals, while those during the night are in Roman. The dial is so arranged that it changes the day of the week at midnight. No ink ribbon is used, the time being embossed.

Arc-Welding Apparatus, Alternating-Current

The Electric Arc Cutting and Welding Co., 222 Halsey St., Newark, N. J.

"American Machinist," Sept. 19, 1918



The illustration shows the entire apparatus for use on a single-phase circuit, the use of alternating current obviating the use of a motor-generator set, switchboard and other apparatus necessary for use with direct current. The watts used are held constant without moving parts, and the heat developed is therefore held practically constant for any given setting. The amount of heat is controlled by means of an adjusting handle of the transformer, together with taps arranged on a plugging board, it being claimed that the efficiency is from 80 to 90 per cent. of the power input. The kilowatt hours required to deposit a pound of mild steel vary from 1½ to 2½. The machine is portable, as the largest size made weighs but 200 lb. Among the advantages claimed over direct-current apparatus are the reduction of wiring and the doing away with moving parts.

Patented Aug. 20, 1918

Personals

Frank W. Taylor is now director of purchases of the Parish & Bingham Co., Cleveland, Ohio.

J. W. Wellington has been made general manager of the Dauch Manufacturing Co., builder of tractors, Sandusky, Ohio.

L. E. Willson has been appointed general sales manager of the Dauch Manufacturing Co., builder of tractors, Sandusky, Ohio.

Henry Summicht, formerly assistant foreman in the local plant of the Edison Lamp Works, Fort Wayne, Ind., has been advanced to manager of the St. Louis branch of the company.

Dwight Davis, for some years assistant to the general manager of the Hyatt Roller Bearing Co., Newark, N. J., is now holding a similar position with the Ever Tight Piston Ring Co., St. Louis, Mo.

F. W. Vormelker has been made efficiency engineer of the Russel Motor Axle Co., North Detroit, Mich., and will have charge of all work pertaining to time study, routeing, factory time, employment and efficiency.

H. R. Garman has been appointed plant manager of the Detroit plant of the Steel Products Co. Mr. Garman has been associated with the company for a number of years as superintendent of the Detroit factory.

John Guyer of the erecting staff of the Shepard Electric Crane and Hoist Co., Montour Falls, N. Y., has gone to France, where he will install 20 overhead electric cranes in the factory of Automobil Berliet, Lyons, France.

F. V. McDonnell, formerly master mechanic of the Pennsylvania Lines West, Northwest system, at Pittsburgh, Penn., has been made master mechanic at Fort Wayne. He succeeds **E. E. Greist**, who resigned recently.

G. J. Messer, master mechanic of the Sioux City and Dakota division of the Chicago, Milwaukee & St. Paul R.R. has been transferred to the Dubuque division with headquarters at Dubuque, Iowa, succeeding **George P. Kempf.**

Frank P. Roesch, formerly master mechanic of the El Paso & Southwestern R.R. has been appointed regional supervisor, Division of Fuel Conservation, United States Railroad Administration, Northwestern District, and will make his headquarters in Chicago, Ill.

O. P. Pendergast, mechanical superintendent of the Texas & Pacific R.R. at Dallas, Tex., has been made mechanical superintendent of the Louisiana & Navigation Co.'s lines west of the Mississippi and the Trans-Mississippi Terminal, with headquarters at Dallas.

F. W. Taylor has been made mechanical superintendent of the Missouri, Kansas & Texas R.R. of Texas, the Wichita Falls & Northwestern, the Fort Worth & Denver City, the Wichita Valley, the Union Terminal of Dalas and the Abeline & Southern, with offices at Denison, Texas.

William Stegman, Milwaukee, Wis., who some time ago resigned as works manager of the Stegman Motor Car Co., now the Parker Motor Truck Co., is now in the sales department of the M. J. Walsh Machinery Co., 144 Sycamore St., Milwaukee, dealer in new and used machine tools and factory equipment.

William E. Harnisson, formerly assistant master mechanic of the Mahoning division of the Erie R.R. at Brier Hill, Youngstown, Ohio, has been appointed master mechanic with an office at Kent, Ohio, and **Ralph R. Munn** has been made assistant master mechanic of the Mahoning division with an office at Brier Hill. He succeeds Mr. Harnisson.

Clarence H. Norton, formerly master mechanic of the Susquehanna, Tioga & Jefferson divisions of the Erie R.R. at Susquehanna, Penn., has been transferred to the Alleghany & Bradford division with headquarters at Hornell, N. Y., and **William Moore**, formerly master mechanic at Kent, Ohio, has been transfered to the Susquehanna, Tioga and Jefferson divisions with headquarters at Susquehanna, Penn.

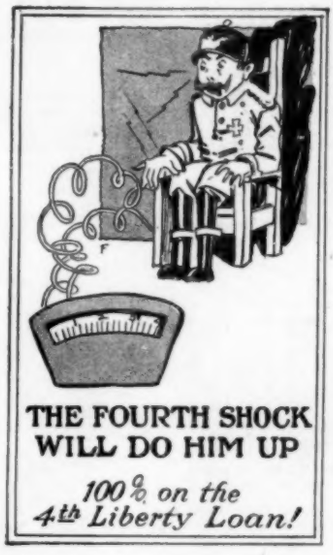
A. I. Davis, formerly master mechanic of the Erie R.R., with office at Hornell, N. Y., has been transferred to the New York division and side lines, having charge of passenger equipment, with headquarters at Jersey City, N. J., and **Lee R. Lavzine**, formerly shop superintendent at Hornell, has been appointed master mechanic of the New York division and side lines, in charge of freight equipment, with headquarters at Syracuse, N. Y.

Guy E. Tripp, formerly colonel in the United States Army and head of the Production Division, has been made brigadier general and placed in charge of offices having charge of the production of ordnance material in their respective sections of the country. The district chiefs will report direct to General Tripp, who is succeeded by **Col. C. C. Jamieson** as head of the Production Division. Previous to his connection with the Ordnance Department General Tripp was chairman of the board of directors of the Westinghouse Electric and Manufacturing Co., New York.

A. E. Brion, president of Peter A. Frasse & Co., Inc., 94 Fulton St., New York, gave a dinner on Sept. 4 at the Columbia Yacht Club, Hudson River and 86th St., to commemorate his 40 years of service with the company. Many representatives of allied industries as well as the directors and members of the company were present. The employees of the company presented Mr. Brion with a monogramed gold watch and chain. On Saturday, Sept. 7, Mr. Brion tendered to the employees of the company a reception and dance, which was held at the main offices of the company at 417 Canal St., New York.

Business Items

John Zipser, formerly general toolroom foreman of the Sperry Gyroscope Co., Brooklyn, N. Y., together with his brother, Alfred, has established the firm of Zipser Bros., at 451 Hudson Ave., Brooklyn, specializing in screw-machine products.



The C. T. Roper Co., Hopedale, Mass., was consolidated on Aug. 1, 1918, with the Hopedale Manufacturing Co. The consolidation was brought about because the treasurer of the Hopedale Manufacturing Co., Clare H. Draper, owned the Roper Co. and desired to bring both companies under one management.

The U. S. Ball Bearing Manufacturing Co., Chicago, Ill., has recently opened two more sales offices, one in San Francisco and the other in Detroit. The new Western office is located at 424 Rialto Building, San Francisco, with S. C. Kyle as manager. The new Detroit office is located at 1437 Dime Bank Building under the management of A. de Maringh.

The George F. Foss Machinery and Supply Co., Ltd., Montreal, Canada, has opened offices at 30 Church St., New York. It was established 25 years ago, and George F. Foss is the president. The firm deals in new and second-hand machinery, and purchases and sells entire plants. It will carry a complete stock of mill supplies in conjunction with its machine-tool business, and it has already introduced its tungsten hacksaw blades, which are in use in Canada in steel and munition plants. Stanly B. Van Deman, well known in New York machinery circles, is the manager.

Obituary

George H. Decker and wife of 7801 Ridge Blvd., Bay Ridge, Brooklyn, N. Y., were instantly killed on Wednesday, Sept. 11, when their touring automobile was struck by a New York, Ontario & Western R.R. train on a crossing near Earlville. Mr. Decker was about 42 years old, and was a manufacturer of shafting and hoisting machinery in New York.

Trade Catalogs

H. & M. Thread Miller. Foster Machine Co., Elkhart., Ind. Circular TM 3. Pp. 4; 8½ x 11 in. It describes and illustrates No. 1 thread-milling machines for brass parts, steel parts, internal and external threads and No. 2 thread-milling machine for threading 155-mm. high-explosive and shrapnel shells. One page is devoted to a number of illustrations showing some of the threads produced on these machines, giving the name and number produced per hour. They are manufactured under Holden-Morgan patents.

Forthcoming Meetings

The American Foundrymen's Association, the Iron and Steel Section of the American Institute of Mining Engineers, the Institute of Metals Division of the Americain Institute of Mining Engineers and the American Malleable Castings Association will hold a joint meeting at Milwaukee during the week of Oct. 7, 1918. There will be a large number of manufacturers represented at the exhibition, to be held in the Milwaukee Auditorium, and many papers will be read. Theodore O. Vilter, president of the Vilter Manufacturing Co., is chairman of the general committee.

The American Society of Mechanical Engineers will hold a meeting of its midwestern sections, including Cincinnati, St. Louis, Chicago, Milwaukee, Detroit, Birmingham and Indianapolis in the last mentioned city on Oct. 25 and 26. It is expected that the Indiana Engineering Society and the Indianapolis Lafayette section, of the American Institute of Electrical Engineers will join in making the arrangements.

American Society of Mechanical Engineers. Monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West 39th St., New York City.

Boston Branch National Metal Trades' Association. Monthly meeting on first Wednesday of each month. Young's Hotel. Donald H. C. Tullock, Jr., secretary. Room 41, 166 Devonshire St., Boston, Mass.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

The National Implement and Vehicle Association will hold its twenty-fifth annual convention in Chicago, Ill., Oct. 16, 17, 18. Headquarters will be at the Congress Hotel. It will be distinctly a war convention.

New England Foundrymen's Association. Regular meeting, second Wednesday of each month. Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn., Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Providence Engineering Society. Monthmonth. A. E. Thornley, corresponding secretary, P. O. Box 796. Providence, R. I.

Rochester Society of Technical Draftsmen. Monthly meeting, last Thursday. O. L. Angevine, Jr., secretary, 857 Genesee St., Rochester, N. Y.

Superintendents' and Foremen's Club of Cleveland. Monthly meeting, third Saturday. Phillip Frankel, secretary, 310 New England Building, Cleveland, Ohio.

Technical League of America. Regular meeting, second Friday of each month. Oscar S. Teale, secretary, 240 Broadway, New York City.

Western Society of Engineers, Chicago, Ill. Regular meetings, first, second, third and fourth Mondays of each month, except July and August. Edgar S. Nethercut, secretary, 1735 Monadnock Block, Chicago, Ill.

WEEKLY PRICE GUIDE OF

IRON AND STEEL

The Government Schedule of steel prices went into effect Sept. 24. Pig iron was set at $33 per ton; pig iron differentials were announced by the American Iron and Steel Institute on Nov. 3. Washington announced sheet and pipe prices on Nov. 5. Warehouse prices have been revised, as shown, by agreement between the War Industries Board and the warehouses; new schedule in effect Nov. 15. Effective Apr. 1, the price of basic iron was fixed at $32, and standard Bessemer at $35.20 at Valley furnace, prices of other irons remaining the same as last quarter.

PIG IRON—Quotations per ton were current as follows at the points and dates indicated:

	Current	One Month Ago	One Year Ago
No. 2 Southern Foundry, Birmingham	$33.00	$33.00	$47.00
No. 2X, furnace, New York	34.00	34.00	53.00
No. 2, Chicago	33.00	33.00	55.00
Bessemer, Pittsburgh	36.60	36.60	52.95
*Basic, Valley, furnace	32.00	32.00	48.95
No. 2X, furnace, Philadelphia	34.40	34.40	53.00
*No. 2, Valley, furnace	33.00	33.00	53.00
No. 2 Southern Cincinnati	36.60	36.60	49.90
Basic, Eastern Pennsylvania	32.90	32.90	50.00

*Delivered Pittsburgh $1.40 more.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$4.245	$4.245	$5.25	$4.17	$5.00	$4.27	$5.00
Soft steel bars	4.145	4.145	5.00	4.07	4.50	4.17	4.50
Soft steel bar shapes	4.145	4.145	5.00	4.17	4.50	4.17	4.50
Soft steel bands	4.995	4.995	....	....	....	....	....
Plates, ¼ to 1 in. thick	4.495	4.495	10 00	4.42	7.00	4.25	9.00

BAR IRON—Prices per 100 lb. at the places named are as follows:

	Current	One Year Ago
Pittsburgh, mill	$3.50	$4.75
Warehouse, New York	4.75	4.75
Warehouse, Cleveland	4.10	4.95
Warehouse, Chicago	4.10	4.50

STEEL SHEETS—The following are the prices in cents per pound from jobbers' warehouse at the cities named:

	Pittsburgh, Mill, in Carloads	New York			Cleveland		Chicago	
		Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
*No. 28 black	5.00	6.495	6.495	10.50	6.42	9.00	6.52	10.00
*No. 26 black	4.90	6.395	6.395	10.40	6.32	8.90	6.42	9.90
*Nos. 22 and 24 black	4.85	6.345	6.345	10.35	6.27	8.85	6.37	9.85
Nos. 18 and 20 black	4.80	6.295	6.295	10.30	6.22	9.20	6.32	9.80
No. 16 blue annealed	4.45	5.695	5.695	10.20	5.62	9.20	5.72	10.20
No. 14 blue annealed	4.35	5.595	5.595	10.10	5.52	9.10	5.62	10.10
No. 10 blue annealed	4.25	5.495	5.495	10.00	5.42	9.00	5.52	10.00
*No. 28 galvanized	6.25	7.745	7.745	12.00	7.67	10.75	7.77	11.50
*No. 26 galvanized	5.95	7.445	7.445	11.70	7.37	10.45	7.32	11.20
No. 24 galvanized	5.80	7.295	7.295	11.55	7.22	10.30	7.47	11.05

*For painted corrugated sheets add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 5c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	List plus 12%	List plus 25%
Cleveland	List plus 12%	List plus 10%
Chicago	List plus 13%	List plus 10%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	35%	40%
Cleveland	20.00	14.30
Chicago	35%	40%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$15.50–19	$14.00
Cleveland	20.00	15.00
Chicago	19.00	13.00

In coils an advance of 50c. usually is charged.

Note—Stock very scarce generally.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100-lb. lots and over:

Welding Wire*		Cast-Iron Welding Rods	
No. 4, 5, 6, 7, 8 and No. 10	22.10 to 33.00	⅛ by 12 in. long	16.00
No. 11		5/32 by 19 in. long	14.00
No. 12		¾ by 19 in. long	12.00
No. 13, No. 14 and No. 15		⅛ by 21 in. long	12.00
No. 18		*Special Welding Wire	
No. 20		⅛	33.00
		5/32	30.00
		¾	38.00

* Very scarce.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Tire	4.14	4.07	4.17
Toe calk	5.75	4.65	4.32
Openhearth spring steel (heavy)	8.00	8.00	8.00
Spring steel (light)	11.00	11.25	11.75
Coppered bessemer rods	9.00	8.00	7.07
Hoop steel	5.00	4.75	5.02
Cold-rolled strip steel	8.50	8.25	8.57
Floor plates	6.50	6.00	7.07

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh; basing card of Nov. 6, 1917, for steel pipe and for iron pipe:

BUTT WELD					
	Steel			Iron	
Inches	Black	Galvanized	Inches	Black	Galvanized
⅛, ¼ and ⅜	44%	17½%	¾ to 1½	33%	17%
½	48%	33½%			
¾ to 3	51%	37½%			
LAP WELD					
2	44%	31½%	2	26%	12%
2½ to 6	47%	34½%	2½ to 4	28%	15%
			4½ to 6	28%	15%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
⅛, ¼ and ⅜	40%	22½%	¾ to 1½	33%	18%
½	45%	32½%			
¾ to 1½	49%	36½%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	42%	30½%	2	27%	14%
2½ to 4	45%	33½%	2½ to 4	29%	17%
4½ to 6	44%	32½%	4½ to 6	28%	16%

Stock discounts in cities named are as follows:

	New York		Cleveland		Chicago	
	Black	Galvanized	Black	Galvanized	Black	Galvanized
⅜ to 3 in. steel butt welded	33%	16%	43%	28%	41.9%	26.9%
3½ to 3 in. steel lap welded	15%	+3%	39%	25%	37.9%	23.9%

Malleable fittings, Class B and C, from New York stock sell at list price. Cast iron, standard sizes, 10 and 5%.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	26.00*	26.00	27.00
Tin in 5-ton lots	78.50	92.00	61.50
Lead	8.05	8.75	8.00
Spelter	9.75	9.00	8.50

*Government price.

ST. LOUIS			
Lead	7.75	8.50	7.75
Spelter	9.50	8.75	8.25

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	New York			Cleveland		Chicago	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Copper sheets, base	38.00	38.00	35.00	38.00	38.00	33.50	38.00
Copper wire (carload lots)	35.00	35.00	38.50	35.00	38.00	33.00	38.50
Brass sheets	39.75	39.75	38.50	37.00	37.00	31.50	38.00
Brass pipe	46.00	46.00	43.00	42.00	46.00	41.50	44.00
Solder (half and half) (case lots)	58.00	60.00	38.00	57.50	39.50	56.00	39.25

Note:—Solder very scarce.

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under: over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill, 100 lb. and over, warehouse: 25% to be added to mill prices for extras; 50% to be added to warehouse price for extras:

	Current	One Year Ago
Mill	$32.25	$30.00
New York	34.25	35.00
Cleveland	36.60	34.00
Chicago	29.50	37.00

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f.o.b. mill 15.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	18.75	21.00	18.40	21.50
New York	16.50	23.00	17.00	23.25
Chicago	22.00	22.50	21.50	23.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	14.00	15.00
Chicago	15.00	17.50
Cleveland	17.125	16.00

SHOP MATERIALS AND SUPPLIES

OLD METALS—The following ar the dealers' purchasing prices in cents per pound:

	New York Current 1918	New York One Yr. Ago	Cleveland Current 1918	Cleveland One Yr. Ago	Chicago
Copper, heavy and crucible	24.00	24.00	24.00	24.75	23.00
Copper, heavy and wire	22.50	23.00	23.50	24.00	23.25
Copper, light and bottoms	20.50	21.00	21.50	22.00	21.50
Lead, heavy	7.25	8.00	.....	8.00	7.35
Lead, tea	5.50	6.75	7.50	6.00	6.50
Brass, heavy	14.75	15.25	16.00	17.00	23.50
Brass, light	11.00	11.50	12.50	13.00	12.85
No. 1 yellow brass turnings	13.75	16.25	14.00	16.00	14.00
Zinc	6.50	6.00	6.50	6.00	6.50

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, guaranteed over 99% pure, in ingots for remelting (1-15 ton lots), per lb.	33.20c.	32.20c.	33½c.

This is the Government price for lots of from 1 to 14 tons.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	32.00	41.00
Chicago	38.00	41.00
Cleveland	36.50	39.00

BABBITT METAL—Warehouse price per pound:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Best grade	110.00	70.00	93.00	69.75	96.00	70.00
Commercial	50.00	40.00	23.00	24.50	25.00	25.00

SHOP SUPPLIES

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Year Ago
Hot pressed square	$2.50*	List	$1.25	$1.65	$1.05	$2.50
Hot pressed hexagon	2.50*	List	1.05	1.50	.85	2.50
Cold punched hexagon	2.50*	List	.75	1.25	1.00	1.50
Cold punched square	2.50*	List	.75	1.25	1.00	1.50

* List plus.

Semifinished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	40%	50%
Chicago	50%	45%
Cleveland	50 + 10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	30%	40+10%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+ 5%	25—5%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:
New York ..... $2.50 Cleveland ..... $1.00 Chicago $2.50

For cast-iron washers the base price per 100 lb. is as follows:
New York ..... $5.00 Cleveland ..... $4.00 Chicago $3.50

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
⅜ by 4 in. and smaller	30%	45%	37%
Larger and longer up to 1 in. by 30 in.	15%	20+5%	25—5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets Current	Rivets One Year Ago	Burs Current	Burs One Year Ago
Cleveland	List plus 10%	List plus 10%	List plus 10%	List plus 10%
Chicago	List price	List price	List plus 20%	List price
New York	20% from list	List plus 10%	List plus 20%	10-2½% from list

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ⅛ and smaller	30%	45—5%	40%
Tinned	30%	45—5%	40%

Button heads, ¾ ⅞, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.
New York..$5.65 Cleveland..$5.15 Chicago..$5.67 Pittsburgh..$4.65

Coneheads, same sizes:
New York..$5.75 Cleveland..$5.25 Chicago..$5.77 Pittsburgh..$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	49.00	42.50	39.50
Brass	40.00	40.00	44.00

For immediate stock shipment 3c. is usually added. The prices of course vary with the quantity purchased. For lots of less than 100 lb. but not less than 75 lb., the advance is 1c.; for lots of less than 75 lb. but not less than 50 lb., the advance is 2½c. over base (100-lb. lots); for less than 50 lb. but not less than 25 lb., 5c. should be added to the base price; and for quantities under 25 lb. the increase above base is 10c.

TIN PLATES—Warehouse prices per box:

Coke tin plate, 14 x 20:

	Cleveland Current	Cleveland One Yr. Ago	Chicago Current	Chicago One Yr. Ago
100 lb.	$10.00	$12.00	$10.60	$11.75
I. C. 107 lb.	10.15	12.17½	10.70	11.90

Terne plate, 20 x 28:

Base Weight	Net Weight	Coating				
100 lb.	200	3	18.95	18.95	19.10	17.90
I. C.	214	8	19.25	19.25	19.40	18.25
I. C.	270	8	21.75	21.75	21.40	20.35
I. C.	218	12	21.75	21.75	22.60	19.25
I. C.	221	15	22.50	22.50	22.10	19.50
I. C.	226	30	23.25	23.25	22.60	20.50
I. C.	231	25	24.50	24.50	23.10	21.30
I. C.	236	30	25.75	25.75	23.60	22.25
I. C.	241	35	26.75	26.75	25.10	23.25
I. C.	246	40	28.00	28.00	25.60	24.65

NOTE—New York prices furnished on application to dealers. Price varies according to whether the plates are wanted for work essential to the war or for nonessential work.

COTTON WASTE—The following prices are in cents per pound:

	New York Current	New York One Year Ago	Cleveland	Chicago
White	11.00 to 13.00	13.00	16.50	12.00 to 16.50
Colored mixed	8.50 to 12.00	12.00	13.00	11.50 to 14.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13¼ x 12¼	13¼ x 20⅛
Cleveland	52.00	58.00
Chicago	48.06	50.00

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.40	2.40	2.10
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$4.30	$4.30	$4.30
Cleveland	4.60	4.00	4.50
Chicago	4.00	4.00	3.80

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past four weeks:

	Sept. 19	Sept. 12	Sept. 5	Aug. 29	Aug. 22
Prompt furnace	$6.00	$6.00	$6.00	$6.00	$6.00
Prompt foundry	$7.00	$7.00	$7.00	$7.00	$7.00

FIRE CLAY—The following prices prevail:

		Current
Chicago	450-lb. bbl.	$2.50
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Cleveland Current	Cleveland One Year Ago	Chicago Current	Chicago One Yr. Ago
Raw in barrels	$1.90	$1.23	$2.10	$1.30	$2.05	$1.27
5-gal. cans	2.00	1.63	2.25	1.40	2.25	1.37

WHITE AND RED LEAD in 500-lb. lots sells as follows in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry and In Oil	White 1 Year Ago Dry and In Oil
100-lb. keg	14.00	14.50	12.25	12.50	14.00	12.50
25 and 50-lb. kegs	14.25	14.75	12.50	12.75	14.25	12.25
12½-lb. keg	14.50	15.00	12.75	13.00	14.50	12.50
5-lb. cans	——	——	14.25	14.00	16.00	14.50
1-lb. cans	——	——	14.25	14.50	17.00	14.50

NEW *and* ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

WASHINGTON, D. C.

The Navy aims to give information regarding its purchases to all manufacturers known to be in a position to supply its demand. Owing to the need of prompt action in the cases of all machine tools hereinafter listed, the Navy cannot arrange to permit a postponement of the opening of bids if the manufacturers are able to secure bidding forms and submit their bids prior to date fixed for opening.

In case time does not permit this, it will be appreciated if any manufacturer not receiving information directly regarding these purchases will notify the Purchasing Division, Bureau of Supplies & Accounts, Navy Department, Washington, D. C., in order that the firm's name may be properly listed for all future purchases.

The Bureau of Supplies and Accounts, Navy Dept., will soon receive bids for furnishing the following machines and machine tools:

Schedule 5779½, two pattern makers' lathes, delivery South Charleston, W. Va.

Schedule 5840½, tanks, rods, one hydraulic jack ad pump, two engine lathes, one planer, one hacksaw and forcing press, delivery Wash., D. C.

Schedule 5841½, one crank shaper, delivery New London, Conn.

Schedule 5941½, three slotting machines, delivery South Charleston, W. Va.

Schedule 5942½, two electric cutting machines, delivery South Charleston, W. Va.

Schedule 5954½, one knife grinding machine, delivery Wash., D. C.

The Bureau of Supplies and Accounts, Navy Dept., will receive bids for furnishing machines and machine tools as follows:

Sept. 27—Schedule No. 5815½, 3 steel threading machines, delivery Puget Sound, Wash.

Schedule No. 5954½, 1 knife grinding machine, delivery Wash., D. C.

Schedule No. 5864½, 1 bench lathe, delivery Norfolk, Va.

Sept. 30—Schedule No. 5779½, 2 pattern maker's lathes, delivery South Charleston, W. Va.

Schedule No. 5841½, 1 crank shaper, delivery New London, Conn.

Schedule No. 5842½, 6 milling machines, delivery South Charleston, W. Va.

Schedule No. 5940½, 2 vertical drill machines, delivery South Charleston, S. C.

Schedule No. 5957½, tool grinder, delivery Puget Sound, Wash.

Schedule No. 5798½, 6 sensitive bench drills, delivery Portsmouth, Va.

Oct. 1—Schedule No. 6015½, cutting grinding machine, delivery Puget Sound, Wash.

Schedule No. 6076½, engine lathe, delivery Brooklyn, N. Y.

Oct. 4—Schedule No. 6071½, special steel shapers, delivery Newport, R. I.

Oct. 7—Schedule No. 5850½, motor and machine tools, delivery Puget Sound, Wash.

The Bureau of Supplies and Accounts, Navy Department, received bids for furnishing machines and machine tools as follows:

Schedule No. 5636½, Class 355, delivery Charleston, S. C., band saws, from J. A. Fay and Egan, John and Front St., Cincinnati, Ohio, $3812; Manning, Maxwell and Moore, 119 West 40th St., New York City, $1475; P. B. Yates Machine Tool Co., Beloit, Wis., $3726; Kemp Machine Co., 233 North Calvert St., Baltimore, Md., $1677; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., $1045, alternate $1495 and $1610; American Woodworking Machine Co., 591 Lyell Ave., Rochester, N. Y., $1837.

Schedule No. 5638½, Class 356, f.o.b. cars, hand drills, from J. Clark, Jr. Electric Co., 520 West Main St., Louisville, Ky., $50 and $54; Cincinnati Electric Tool Co., Freeman and Flint St., Cincinnati, Ohio, $53.50; W. F. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., $59; Hiesey Wolf Machine Co., Colerain and Marshall St., Cincinnati, Ohio, $69; Independent Pneumatic Tool Co., 1307 Michigan Ave., Chicago, $54; Kemp Machinery Co., 233 North Calvert St., Baltimore, Md., $38, alternate $50; Manning, Maxwell and Moore, 119 West 40th St., New York City, $58; National Electric Supply Co., 1330 New York Ave., Wash., D. C., $46; Patterson, Gottfried and Hunter Co., 211 Center St., New York City, $60; Black and Decker Manufacturing Co., 105 South Calvert St., Baltimore, Md., $45; Stow Manufacturing Co., 445 State St., Binghamton, N. Y., $53.

Schedule 5646½, Class 366, delivery Puget Sound, Wash., crank shapers, from Hollingsworth Machine Tool Co., Covington, Ky., part bid, $4200; Manning, Maxwell and Moore, 119 West 40th St., New York City, $11,834; Niles, Bement Pond, 111 Broadway, New York City, $8820, part bid. Class 367, shaper, from Martin Manufacturing Co., Muskegon, Mich., $5900. Class 368, delivery Puget Sound, Wash., vertical milling machine, from Brown Sharpe Manufacturing Co., Promenade St., Providence, R. I., $4184; Chicago Pneumatic Tool Co., 343 South Dearborn St., Chicago, $4152.

Schedule 5517½, Class 346, delivery Newport, R. I., tool post grinders, from Kemp Machinery Co., 233 North Calvert St., Baltimore, Md., $75; Manning, Maxwell and Moore, 119 West 40th St., New York City, $80; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., $80; D. Weeks Machine Tool Co., 1270 Broadway, New York City, $68.50; Wisconsin Electric Co., 16th and Junction Ave., Racine, Wis., $53.33; F. Toomey Co., 127 North 3rd St., Philadelphia, Penn., $64; Stow Manufacturing Co., 445 State St., Binghamton, N. Y., $55, alternate, $65.

Schedule 5512½, Class 345, delivery Philadelphia, Penn., boring machine, from Defiance Machine Works, Defiance, Ohio, $12,727; Kemp Machinery Co., 233 North Calvert St., Baltimore, Md., $6546; Monarch Machine Co., 300 North 3rd St., Philadelphia, Penn., $6165; D. Nast Machine Co., Bourse Bldg., Philadelphia, Penn., $4850, alternate, $4980; Swind Machine Co., New York City, $6683; Vandycke Churchill Co., Bourse Bldg., Philadelphia, Penn., $4676; Sherritt and Stoer Co., Finance Bldg., Philadelphia, Penn., $6402; The Fairbanks Co., Colorado Bldg., Wash., D. C., $6391.

Schedule 5516½, Class 351, delivery Newport, R. I., bench grinders, from W. F. Davis Machine Tool Co., 945 Pennsylvania Ave., Wash., D. C., $109; the Hisey Wolf Machine Tool Co., Colerain Ave. and Marshall St., Cincinnati, Ohio, $89; Kemp Machinery Co., 233 North Calvert St., Baltimore, Md., $88; Manning, Maxwell and Moore, 119 West 40th St., New York City, $78; Roth Bros., 1400 West Adams St., Chicago, $98; J. Clarke, Jr., 520 West Main St., Louisville, Ky., $103.50.

Schedule 5510½, Class 353, delivery Norfolk, Va., milling machine from Brown and Sharpe Manufacturing Co., Promenade St., Providence, R. I., $18,823; Cincinnati Milling Machine Co., Marburg Ave. and South St., Oakley, Cincinnati, Ohio, $44,249; Cleveland Milling Machine Co., 18511 Euclid Ave., Cleveland, Ohio, part bid, $3125.

Schedule 5327½, Class 356, delivery Wash., D. C., crank slotters, from Manning, Maxwell and Moore, 119 West 40th St., New York City, $3673; Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn., $6500; Niles Bement Pond Co., 111 Broadway, New York City, $4130; Kemp Machinery Co., 233 North Calvert St., Baltimore, Md., $3150; Sherritt and Stoer Co., Finance Bldg., Philadelphia, Penn., $5625.

Schedule 5636½, Class 369, delivery Puget Sound, Wash., milling machines, from Brown and Sharpe Manufacturing Co., Promenade St., Providence, R. I., $3019; Chicago Pneumatic Tool Co., 343 South Dearborn St., Chicago, $3657. Class 370, boring mills, from Bethlehem Steel Co., Bethlehem, Penn., $29,620. Class 371, spline milling machine, from D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., part bid, $73; Pratt and Whitney Co., 436 Capital Ave., Hartford, Conn., $2120.

Schedule 5653½, Class 372, delivery Puget Sound, Wash., lathes, from Monarch Machine Tool Co., Sidney, Ohio, $1875; Manning, Maxwell and Moore, 119 West 40th St., New York City, $2534; Niles Bement Pond, 111 Broadway, New York City, $2620; Perine Machinery Co., 209 1st St., S., Seattle, Wash., $2530; Kemp Machinery Co., 233 North Calvert St., Baltimore, Md., $1953. Class 373, planer, from Bethlehem Steel Co., Bethlehem, Penn., $114,725. Class 375, lathe, from Manning, Maxwell and Moore, 119 West 40th St., New York City, $21,196; Niles, Bement and Pond, 111 Broadway, New York City, $26,005. Class 375, turret lathes, from Warner Swasey Co., 5809 Carnegie Ave., Cleveland, Ohio, $4610, alternate, $6371. Class 376, pipe threading and cutting machines. Class 377, tool grinders. Class 378, power hack saw. Class 379, centering machine. Class 380, drill presses. Class 381, vertical presses, from Manning, Maxwell and Moore, 119 West 40th St., New York City, (376) $4304, (377) $135, (378) $351, (380) $1851, (381) $165; Niles, Bement and Pond, 111 Broadway, New York City, (376) $4930, (380) $2040; D. Saunders and Sons Co., 21 Atherton St., Yonkers, N. Y., $2714, alternate, $2971; Cincinnati Electric Tool Co., Freeman and Flint St., Cincinnati, Ohio, (377) $142; The Hisey Wolf Machine Co., Colerain Ave. and Marshall St., Cincinnati, Ohio, (377) $174; Kimball Electric Co., Chicago, (377) $210; Kemp Machine Co., 233 North Calvert St., Baltimore, Md., (377) $137, alternate, $95, (378) $226, (381) $159; Marschke Manufacturing Co., Indianapolis, Ind., (377) $325; D. Nast Machinery Co., Bourse Bldg., Philadelphia, Penn., (377) $140, alternate, $119, (380) $2125, alternate, $2100; Perine Machine Co., 209 1st St., S., Seattle, Wash., (377) $120, (380) $2473; Smith Booth Usher Co., 228 Central St., Los Angeles, Calif., (377) $164; U. S. Electric Tool Co., 2488 West 6th St., Cincinnati, Ohio, (377) $160, (381) $178; Webster and Parks Tool Co., Shuey Bldg., Springfield, Ohio, (377) $169; Sherritt and Stoer Co., Finance Bldg., Philadelphia, Penn., (377) $285, (378) $295; J. Clarke, Jr., Electric Co., 520 West Main St., Louisville, Ky., (377) $140, (381) $156; Peerless Machine Co., 1516 Racine St., Racine, Wis., (378) $285; Pratt and Whitney Co., 436 Capital Ave., Hartford, Conn., (379) $600; Carlton Machine Tool Co., Spring Grove and Meeker St., Cincinnati, Ohio, (380) $2000; Mueller Machine Co., 2427 Colerain Ave., Cincinnati Ohio, (380) $1675; Swind Machine Co., New York City, (380) $2100.

Schedule 5648½, Class 383, delivery Puget Sound, Wash., cold cutting machine, from Earle Gear and Machine Co., Philadelphia, Penn., $8735; Greenfield Tap and Die Corporation, Greenfield, Mass., $4882; Manning, Maxwell and Moore, 119 West 40th St., New York City, $8861; Newton Machine Tool Works, 23rd and Vine St., Philadelphia, Penn., $5450; Niles, Bement and Pond, 111 Broadway, New York City, $9030.